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AMERICAN MACHINIST

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Testing and Accumulator Pumps.

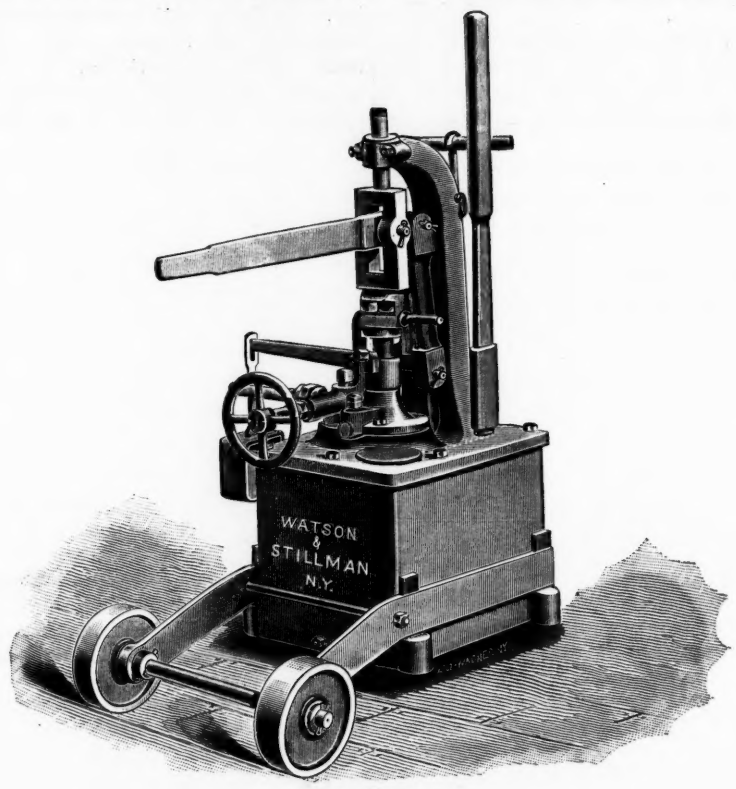
We illustrate herewith two pumps which have recently been brought out by Watson & Stillman, of New York City, the smaller pump being designed as a test pump for hydraulic or other machinery requiring to be tested at very high pressures.

The base of the machine is a cistern or reservoir for holding the water, and it is mounted on wheels, as shown, so that it may be taken to any part of the shop.

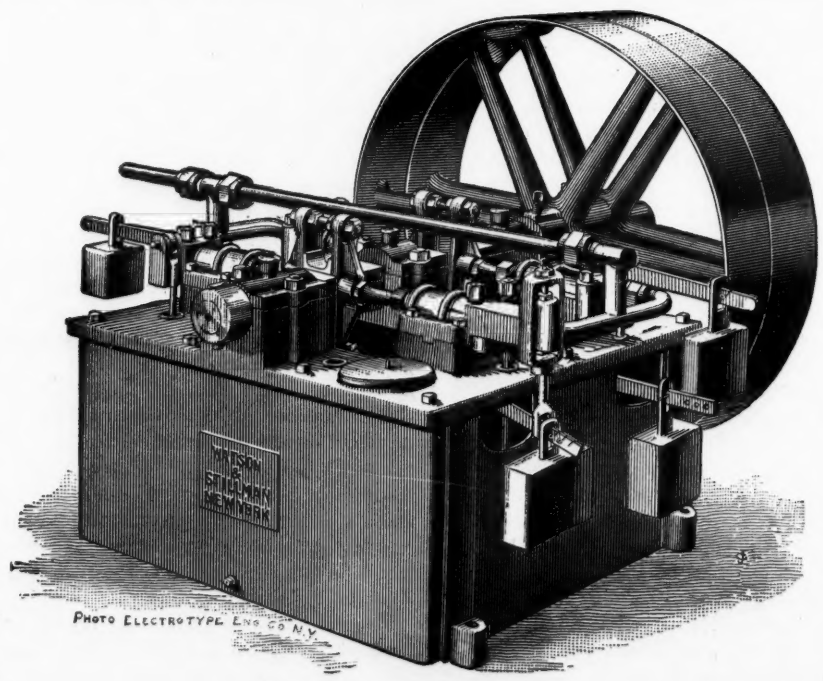
There are only three wheels, so that the machine rests solidly upon any uneven surface, the one at the rear being swiveled so that the machine is drawn about over the floor by means of the handle, the top of which is seen at the back. The object in carrying the two wheels out in front so far is to avoid the tendency to tip the machine over when the lever is extended to its full length for the heaviest pressures. This extension is effected by means of the socket lever seen standing at the back of the machine, which slips over the regular lever, a stud being provided for it on the base of the machine when not in use.

The pump is a double piston machine, the smaller piston working through the center of the larger one, and is intended to work up to 10,000 pounds per square inch. Attached permanently to the lower part of the yoke in which the lever works is the small plunger, which is $\frac{3}{4}''$ diameter. The larger plunger, which is $1\frac{1}{2}''$ diameter, surrounds the smaller one, and when the pumping begins, before the pressure reaches a high point, the larger plunger is attached also to the yoke, and moves with the smaller plunger, the two, in fact, making one plunger $1\frac{1}{2}''$ diameter. When the pressure rises as high as it can be carried with the large plunger, the clutch referred to, and which is seen just below the yoke, is swung around by the small hand lever, this movement releasing it from the yoke, and locking it to the pump barrel, so that the smaller plunger only continues to move, and the pressure can be carried to any desired point up to the maximum. The machine as shown weighs about 275 pounds. For boiler testing a larger machine is built, by which pressure can be raised more quickly, but in which the maximum pressure attainable is of course not nearly so high.

The larger machine is for pumping for an accumulator, or for any kind of hydraulic machinery and tools, and is known by the makers as the "automatic, variable delivery, four plunger belt pump of the crosshead pattern." This designation is really descriptive of the machine. There are four plungers, which, when the pumping begins, or while the pressure is low, all work together with the maximum delivery. When the pressure reaches a certain predetermined point, small pistons which are subjected to this pressure rise against a yoke which is loaded, and which, by its upward movement, comes into contact with a stem which is attached to the suction valve, preventing this valve from seating. Thus the water which is drawn into the pump chamber is simply returned to the cistern at the reverse stroke, and no water is pumped by this piston, though the pressure is retained by the valve in the delivery pipe, and the high-pressure pistons go on working at the higher pressure. The operation of the high-pressure pistons may be stopped in the same way—automatically or by hand, as may be desired. Thus it will be seen that all changes are made from the lowest pressure with maximum delivery, up to the highest pressure with minimum or no delivery, without shifting the belt, and with the pumps in full motion ready to again deliver water whenever the falling pressure allows the suction valves to again come to their seats; and, while the pressure is low the delivery is correspondingly fast.



TEST PUMP.



FOUR PLUNGER BELT PUMP.

It is reported that the Red D line steamship "Philadelphia" is to be lengthened by cutting her in two, and inserting a new center 36 feet long. Her present length is 269 feet. The work is to be done at Cramps' shipyard in Philadelphia.

Springs or Weights.

BY W. H. BOOTH.

There are certain applications of balance weights which bear on their face clear evidence that the designer wholly overlooked, or was even ignorant of the action of gravity—we mean of that particular action which is illustrated by the students' well-known Atwood's "Machine of the Lecture Room."

In Atwood's machine the action of gravity is experimentally illustrated and measured by means of a falling weight, the fall of which is capable of regulation.

We know that when a weight falls freely under the action of gravity, and when it is of such density as to receive only infinitesimal resistance from the atmosphere, it will attain a velocity of about 32 feet per second at the end the first period of a second during which it has fallen from rest, and that a further velocity of 32 feet per second is added during each second of fall. In the Atwood machine a falling weight draws after it a fine flexible cord, which passes over one wheel above whose bearings are the rims of large friction wheels. The weight has thus practically no friction to overcome.

To the other end of the suspension is hung any other desired weight.

Let us suppose at each end of the cord is hung a weight of one pound (or 1 unit).

There would be no motion, for the system would be in equilibrio, each weight's tendency to fall being resisted by an equal pull upwards due to the opposite weight. Stated briefly, the two weights balance one another. We all know what this means in plain English, free from the terminology of the professors. Let there be now added a third weight, also of one pound. Then on one side a load of two pounds will overcome the single pound on the other side.

Seeing that two of the weights balanced, we may now say that the motion of the three weights of a pound each must be entirely due to the gravity of the last added weight, which has no fourth weight to balance it. Thus, then, a weight of one pound falling by gravity has to set in motion not only itself, but other two pounds beside. The gravity of one pound, in fact, is dispersed among three pounds, and were we to note the fall or motion during one second of time we should find that not 16 feet, but only 5 feet 4 inches would be traversed by the moving weights, and, similarly, had there been $1\frac{1}{2}$ pounds on one side and $2\frac{1}{2}$ pounds on the other, the rate of motion of the total weight of 4 pounds would be due to the difference, or to $2\frac{1}{2} - 1\frac{1}{2} = 1$ pound only, and, as this is only a fourth of the total moving load, the speed attained in one second would be 8 feet only, in place of 32 feet, and the space passed through, 4 feet instead of 16 feet.

In the Atwood's machine there are certain collars fixed, through which the weights can fall. It is thus easy, by using a weight of larger diameter than the collars, to so arrange matters that any weight can be taken off the falling load by such collar at any period.

In this way a certain load arrangement can be allowed to act for say one second of time, at the end of which the acting weight can be lifted off by the collar and the time noted after this point, when the load passes any other point.

Thus an acting weight of 1 moving a total load, including itself, of 4, will fall 4 feet in one second, and if at the end of a 4-feet fall the lift off collar take away the acting 1 and leave the two balanced pans of an aggregate load of 3, it would be seen that they would traverse 8 feet during the next second; for in falling the 4 feet in the first second they would attain a velocity of 8 feet per second, and, the accelerating load being removed, they would continue at this velocity until stopped by friction and air resistance. In this way are shown in the lecture room the actions of the force gravity.

What specially concerns us, however, is to note how very serious is the diminution of velocity—due to balancing part of a fall-

ing load; and if we clearly recognize the principles involved, we can design accordingly and avoid error.

Suppose a heavy pump spere rod be wanted balanced, how is it to be done?

In a slow moving pump we should do this simply by a lever and opposite moving balance weight, because the inertia of both the pump rods and the balance bob would be gradually overcome at the ends of the stroke.

Suppose, however, that a rock-boring is being undertaken, in which the action of the cutting tool depends upon the smart blow of a falling chisel. As the hole deepens, the length, and therefore the weight of the boring rods, becomes very great, and in excess of that necessary to give a sufficient blow, and yet, of course, the sharpness of the blow becomes no greater with the heavy rods than with the light.

Some brilliant genius at this moment suggests balancing part of the rods. He says, we may suppose, 100 feet of rod are all we require, and we have got now 300 feet. Let us balance 200. He therefore hangs over the overhead pulley a weight equal to 200 feet of rods, so that instead of a weight of 3 there is now a weight of 5 in motion, and in place of each unit of load having a unit of actuating or falling weight, there are 5 units of moving load actuated by 1 unit of unbalanced falling weight. The result simply is that the smartness of the blow is reduced 80 per cent., and progress is retarded and the balancing falls into disfavor.

If, however, a spring be used as a back resistance, the results are quite different. In the first place, a spring has no inertia due to weight, and does not detract from the sharpness of the blow. The resistance of the spring, which is small when the pump rod is raised for a blow, begins to increase and reaches a maximum at the end of the fall. Thus every foot of falling weight may, if desired, be made to act at the commencement of the fall, and yet a resistance spring will greatly assist the upraising after the blow, and this, too, without so seriously diminishing the smartness of the cut as does a balance weight. For a boiler safety valve there need be very little room for choice between a load by weight and by spring, but in such a case there is never any rapid motion necessary.

Take the opposite case, however, of a water relief valve on a steam engine cylinder.

Such a valve is wanted to be heavily loaded, and yet it must act smartly.

There have been cases where such valves have been loaded by weights, and have been called on to relieve the cylinder of a sudden flush of water. What has been the result? Simply that, though the valve did act smartly enough and let out the water, and so saved the cylinder cover, yet, as a whole, the valve did not act, for the loading weight remained motionless, or nearly so. It could not be moved by the sudden pressure of the water on the valve with sufficient rapidity to let the water out in the time which the piston motion compelled as necessary, and yet the water *was* let out. In short the lever bent. The lever had little weight, and so was quickly moved, and its resilience was of course ot no inertia, and so the lever bent. Had it failed to bend then, the fulcrum pin might have sheared, and had this stood the stress, perhaps the new engine would have been fitted with a spring-loaded valve.

A certain valve is wanted to shut quickly. To effect this we do not add weight to it, unless it be to overcome some unavoidable friction or retarding load, because we know that no additional weight will increase rapidity of fall. What we do is to add the pull of a spring to the closing motion, and if the valve weighs ten pounds, and we attach a spring pulling another ten pounds, we shall double the velocity of closing; for a spring which will pull ten pounds will weigh next to nothing comparatively.

In bringing any moving weight to rest by causing it to impart motion to another weight, we incur the disadvantage that we set a fresh load in motion at a considerable velocity, and the newly started load then ceases to be valuable as a stop, by so much as it has acquired velocity, and there is always the difficulty in effecting the first transferrence, because the weight to be stopped is moving at its highest speed when the absorbing weight has to be moved from rest, whereas a spring absorber can start out at full speed and increase its resistance until it finally overcomes the rapidly decreasing momentum of the moving load which is to be stopped.

Men who ought to know better will seriously argue that half a falling load may be balanced by a weight of opposite motion without any change in the velocity of fall being brought about. This is, of course, a serious error, for the velocity of any system of loads will always be reduced to $\frac{W-w}{W+w}$ of that of a free falling load where W is the falling load and w is the rising or balance portion—the total moving mass being $W + w$, and the working or net falling load being $W - w$.

It is easy, therefore, to see how very seriously reduced must be the velocity of fall where w is anything more than $\frac{W}{4}$, and how important, therefore, it is to select a weight or a spring to fill a certain office instead of selecting the spring where a weight should be employed, or *vice versa*.

There are positions where advantage may be claimed for either.

The link motion of a locomotive is balanced—in England by a weight, in America by a spring. The English design is the more correct when we consider the effects of the road in jolts and up and down motion, for the weight will always balance the motion, but the spring is more correct from the point of view of the man who has to pull the lever over and overcome the inertia of the parts.

Perhaps the straight link, which is more or less self-balancing, is better than either method.

Examples will perhaps suggest themselves readily to those who are interested in this subject. No doubt many have seen such mistakes as the weight-loaded relief valve, which is about as rational as using a light spring beam as an anvil.

Recently the night schools have been opened in Jersey City, and the large number of applicants for admission show the wisdom of establishing such schools. It is unfortunate that, in the general distribution of the earnings of the people, there shall not be enough to give every boy a fair education during the day, but failing this, it is wise to give him a chance at night.

The money which the abundant harvest has set in motion will soon begin to seek profitable employment, and then business will boom. There is, at present, every indication that the United States is on the eve of the greatest prosperity this country has ever known.—*Detroit Tribune.*

Locomotive Valve Gear on the Boston, Revere Beach & Lynn Railroad.

BY PROF. JOSEPH TORREY.

During my vacation this summer I rode for the first time on the narrow gauge line known by the above name. As I stood in the depot I noticed that the train was quite long and heavy, so, having taken my seat in the car, I waited with considerable curiosity to see how it would move off. The start was suggestive of a very smart engine; in fact, the train was well up to speed before it had gone its length. At every station on the way the same thing was noticed. When the train pulled into East Boston I stepped forward to take a look, and see if there was any visible peculiarity which would account for such creditable performance. Immediately my attention was arrested by the peculiar valve gear shown in Fig, 1. A few moments' study showed the elements of the motion, which were rapidly sketched down and "laid out" in due form the same evening. As the points' combination showed themselves under more careful scrutiny, there seemed to be much that was of interest in it, and I determined that at the earliest opportunity the readers of the AMERICAN MACHINIST should have a description of it.

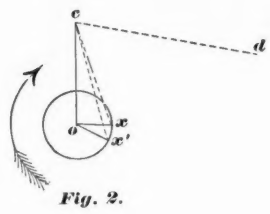
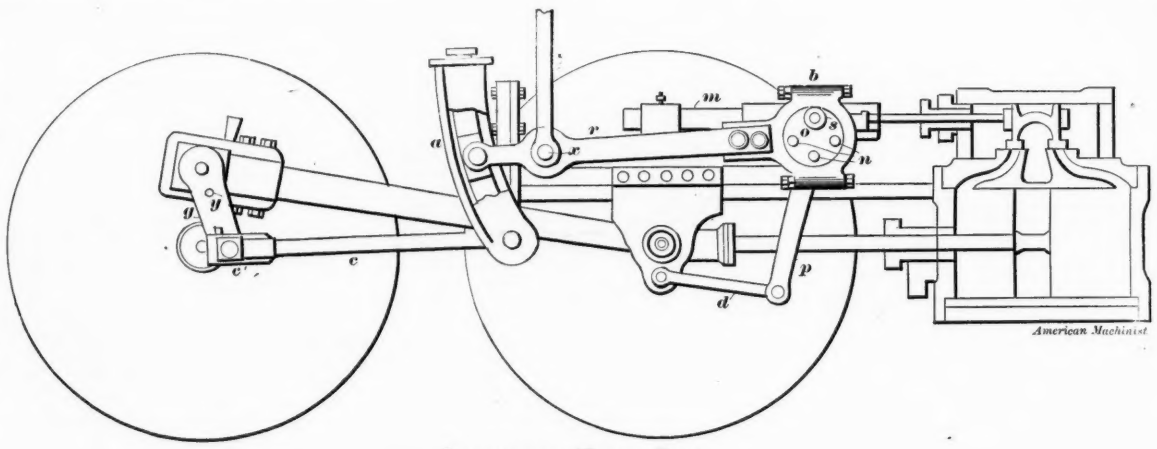


Fig. 2.



LOCOMOTIVE VALVE GEAR.

The road went into operation in 1875. The first locomotives used were built by the Mason Locomotive Works, of Taunton, Mass., one of the oldest of American locomotive manufacturers. The engines were fitted with the valve gear shown in the figure, which contains the elements of the well-known "Walschaert" motion, which is used on Continental locomotives to some extent. As first set up, the gear was defective—not as to steam distribution, probably, since there has been no change in the elements, but in respect to strength, wearing surface and simplicity. During the time the locomotives have been in service the conditions have been under careful study, and the attempt has been constantly to strengthen parts, reduce number of joints, and insure good wear. At the present time the proportions are such as to attain these desirable results in a great degree.

I had hoped to be able to give a more detailed description than is possible now, but I shall be obliged to confine myself to a rather general one now, and reserve particulars as to steam distribution until some time when leisure is more abundant.

The figure shows plainly all the essential features. The parallel rod is omitted, and the driving wheels are only indicated by circles to save detail in the drawing. The central figure of the gear is the stationary link *a*, which is pivoted to an offset in the frame. As shown in the figure, the block is in mid gear, and since the link is stationary its vibration imparts no motion to the valve.

The link is actuated by the rod *c*, which is pivoted to the lower end of the link at one end, and at the other to the arm *g*, which is firmly keyed to the end of the crank-pin, much as in the well-known Rice automatic engine. At first sight this arrangement does not strike one favorably. It seems as if the pin was the last place to put additional strain, and in the earlier locomotives some trouble resulted, I believe. At present it is found that if the crank-pin is properly put in to begin with, trouble is as rare as could be expected in any mechanism accomplishing the same purpose. It will be noticed that the end *c'* of this arm is swung away from the center line, and this gives, as the wheel revolves, all the effect of an eccentric motion. The amount of angular advance is determined by the length of the arm, as is clearly shown by Fig. 2, which shows center lines only. Let *c d* be the center line of part of the connecting rod. Let *c o* be the center line of the crank. Now if the arm had the length *c x* it would, when swung off sufficiently to give the right amount of valve travel, give an angular advance of closely 90 degrees. But if its length were *c x'* the angular advance would be *c o x'*, or more than 90 degrees, the direction of rotation being as indicated. The throw line of the eccentric movement passes, of course, through the centers of the driving wheel and the pivot *c*. There is no shifting of this arm *c c'* after it is once put in place. In assembling the engine this arm is first put on temporarily, and the valve adjusted as usual. When the correct position has been found the round key *y* is driven, and, as it goes half into the pin, and half into the arm, its position is thereafter fixed.

By far the most interesting piece in the whole motion, however, is that marked *b*. It has all the appearance of an eccentric and strap, as will be seen, but its motion is very different from that of an ordinary eccentric, in that the disk revolves on its own geometrical center, and communicates motion to the stud *s*, just as if it were a bent lever pivoted at *o*, having one end at the center of stud *s*, and the other end at *p*. The disk is rotated, or rather *rocked* back and forth by the arm *p*, which is secured at its lower end to a link connected with the crosshead. The upper end is forked and secured by three bolts to the disk. The stud *s* is connected on the back side of the disk, with a sliding piece moving on generous bearing surfaces, and carrying the valve rod. As the crosshead travels back and forth the disk receives a motion which strongly reminds me of the so called "wrist-plate" motion. The strap *b* connects by the usual rod with the link block, and the lifting shaft is fastened at *x*,

Now the valve receives from this gear a motion which differs according to the amount the block is hooked up. When the block is in mid gear the valve is only moved by the piece which we will call—as it is called in the shops—the "eccentric." At any other time it receives a motion compounded of that resulting from the "eccentric" and that imparted by the link block. The distance of the stud *s* from *o* is so proportioned as to give a movement just sufficient to take up the lap of the valve, and open it to the amount of the lead. If, then, the block be in mid gear, this will be the total amount of port opening, and cut-off will be correspondingly early. Now if the block be dropped two or three notches, the block, and consequently the "eccentric," begins to acquire motion from the link. The travel of the valve becomes proportionally greater, and cut-off later.

The motion of the valve rod is now a very peculiar one, being very rapid at admission and cut-off, but comparatively slow between these points. Thus, by looking at Fig. 1, and following in imagination the motion and events for one revolution, it will be seen that from the beginning of the piston stroke to about half stroke the movements of the link block and the stud *s* are in opposite di-

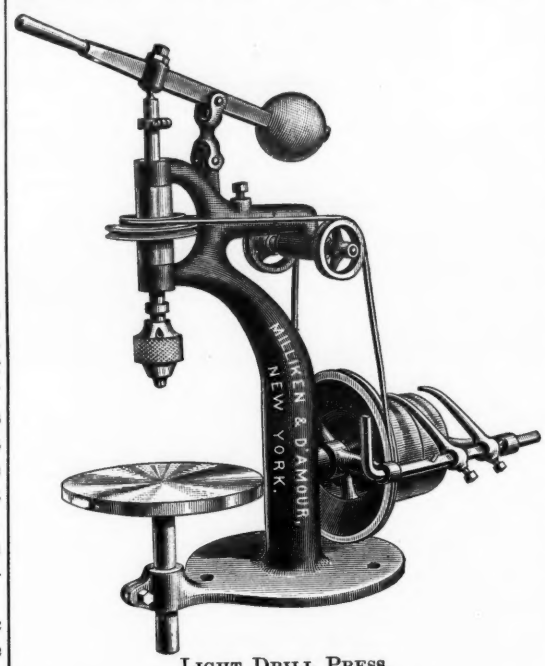
rections, then they join forces and give a considerably accelerated motion to the valve, which motion lasts well through the exhaust period. The same movements characterize the return stroke. The result of the retarded motion during the early part of the stroke is to bring about a slower motion of the valve up to the time it begins to return for the cut-off. This feature shows very decidedly in the working of the locomotives. Trains relatively heavy are handled with a promptness and ease which is very pleasing, and, once up to speed, a heavy train is carried along at a rattling pace with the lever in the center notch, or perhaps one notch away. This is very well, but to my mind not so noteworthy as that the lever can be dropped *forward* several notches before any notable decrease in speed ensues. It is a well-known fact that the ordinary locomotive running well hooked up will drop speed immediately on dropping the links forward so much as one notch. This is due to the small exhaust nozzles in use on most locomotives. In the locomotive under consideration the exhaust nozzles are notably larger than is common. This point will be referred to again when the question of steam distribution is considered more in detail.

The link is virtually duplex, the eccentric rod entering between the halves and the block having a double bearing. Formerly a single link was employed, but it was found that irregular wear and considerable strain resulted from this arrangement. The present link gives no trouble. It will be noticed that the stud *s* would *tend* to move in a small arc around the center *o*, but as the only point of support of the "eccentric" disk is at *s*, the result is that the tail wags the dog, and the stud *s* moves in a straight line, the center *o* moving slightly up and down.

I will now give some of the general dimensions of the standard bogie locomotive, from which this drawing was made: Total weight, 76,700 pounds; weight on drivers, 38,500 pounds; cylinders, 14″x18″; diameter of drivers, 48″; steam ports, 11½″x1½″; exhaust port, 11½″x2½″; bridges, ⅞″; valve travel, 4½″; outside lap, ⅝″; inside lap, $\frac{1}{32}$″. The lead I do not recall, but these dimensions are given so that it can be judged how far any excellence of performance can be laid to construction and conditions.

The AMERICAN MACHINIST has always been the sturdy champion of the link motion as ordinarily employed, and time has proved the wisdom of its position. It is one of the most remarkable mechanical facts in existence, that while the problem of locomotive valve gears has been before inventors for forty years and over, practically nothing has come forward to supersede the standard link motion. There has never been a time when there were not those who ridiculed it, and would have been glad to depose it if there had been anything to replace it with, but there has always been present the fact that under the same conditions the performance of the link was really wonderful. As a matter of fact, if cards from an ordinary good automatic stationary engine be taken at 350 revolutions per minute, and if cards be taken from a locomotive of the same size of cylinder and length of stroke at the same speed, the cards will not show a difference of much over 10 per cent., sometimes not as much as this. Give the locomotive a fair chance on the exhaust, which it does not usually have, and the difference will be still less.

I am aware of the record of the "Strong" and "*Stevens*" valve gears, both of which have made good records as regards steam distribution, but I know nothing as to their wearing capacity or their behavior under the trying conditions of railroad service. I have wished many times that we might know more of their progress and capabilities. There is nothing so difficult as to compare locomotives. For instance, I looked up the records of some tests that were made on the efficiency of the locomotive described in this paper, but I confess I could not come to any definite or satisfactory conclusion. It was pretty certain that in a general way the locomotives fitted with this valve gear were more efficient than the one standard link motion engine on the line, but the difficulty is that the standard link had a very inferior locomotive over it, and all the difference may have been there. The fire-box and

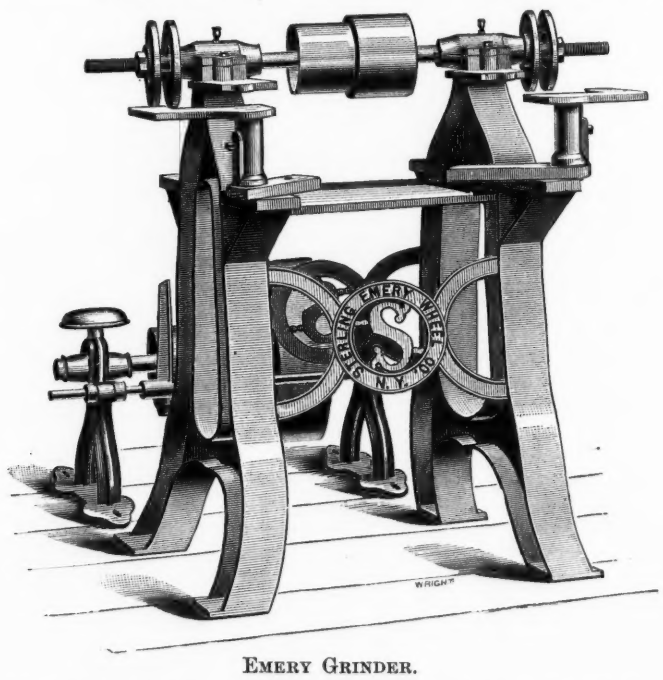


LIGHT DRILL PRESS.

boiler have something to do with coal consumption, be it remembered.

When a new valve gear is tried it is usually on a particularly good engine, and the results are not always safe to follow.

Now the object of presenting this engine to the readers of the AMERICAN MACHINIST is not to make any extravagant claim for it, only to place it so it can be clearly seen. It certainly has some good points. It is all



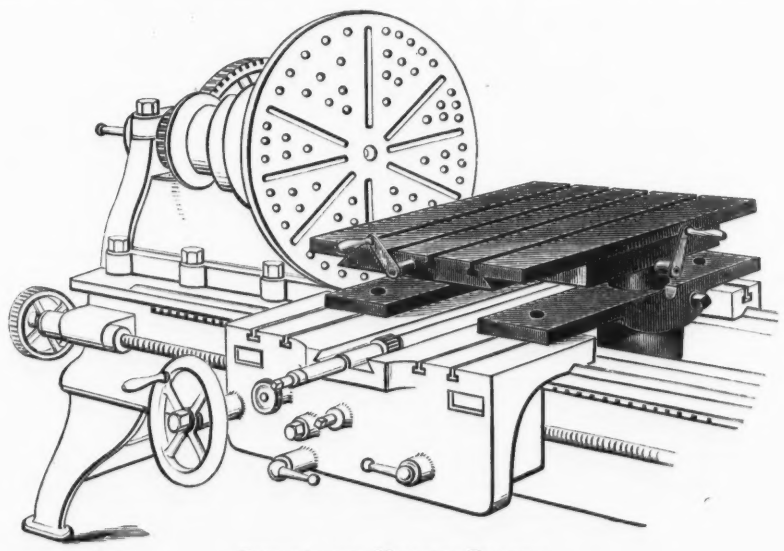
EMERY GRINDER.

out in sight, and accessible, for one thing. It handles its trains well, does not give any more trouble at the shops than the ordinary gear, and shows very satisfactory wear. I do not say that it would perform equally well on a standard gauge locomotive, although I can see no good reason why not. It has a history behind it now; not a long one, perhaps—only about fifteen years—but enough to show what it can do. I have been unable so far to get time to get diagrams of the steam distribution, but will reserve these for a future paper, together with some interesting points of constructive detail. In conclusion, I wish to express my thanks to Mr. C. A. Hammond and Mr. R. D. Sutherland, superintendent and master mechanic respectively of the road, who have furnished information on many points, and given me every facility for studying what I consider a very interesting, noteworthy little locomotive.

Light Drill Press.

The accompanying illustration shows a light drill press intended to be set on a bench and to do light work, such as is done on electrical machinery, etc.

The general features of the machine will be readily understood from the engraving, and it is only necessary to say that the pulley which is on the spindle has its bearings on bronze sleeves which are pressed into the frame of the machine, and which also form the bearings through which the spindle slides, this arrangement entirely doing away with belt strain on the spindle. The idler pulleys are so placed that the belt is about equally deflected at either speed, and both the loose pulley and the driving pulley run on a fixed stud fastened to the frame of the



BORING AND MILLING PLATEN.

machine, the larger cone pulley being made fast to the driving pulley. When preferred, the countershaft can be above the machine, either on the ceiling or on the wall, and when this is the case the arm which supports the idler pulleys is loosened in the frame and turned half way around, the lower edges of these pulleys then occupying the same position as the upper edges occupy in the engraving. The arm is secured in position by the set-screw seen.

The counter weight is movable on the lever to compensate for tools of different weights, and there is a ball and socket joint where the lever is attached to the spindle, this joint being so arranged that all lost motion can be taken up.

The spindle is of steel, ⅝″ diameter; table, 7″ diameter; distance from center of table to column, 5″; range of holes drilled, from the smallest to $\frac{5}{16}$″. The machine is shown fitted with an "Almond," but can, of course, be fitted with any drill chuck. Driving pulleys are four inches diameter for a one-inch belt. The machine is built by Milliken & D'Amour, 151–153 Cedar street, New York City.

Emery Grinder.

The accompanying engraving represents an emery grinding machine designed for use in machine shops, textile mills, planing mills, brass and iron works, and generally wherever a moderate amount of grinding is to be done, and a machine of medium weight is required. It is designed to use wheels up to 12″ or 14″ diameter.

The arbor is 36″ long, giving a distance of 24″ between wheels, so that two men may work at the machine at the same time. The spindle is of steel 1¼″ diameter in the bearings, which are 6″ long.

The flanges are 6″ diameter, and the height from the floor to the center of spindle is 36″. The machine weighs, including countershaft, about 300 pounds. The makers are the Sterling Emery Wheel Co., 174 Fulton street, New York City.

Boring and Milling Platen for Lathes.

The illustration presented herewith shows an attachment intended to be used with any gibbed lathe and to enable jobs of boring, facing or milling to be readily done on it which would ordinarily require a boring or milling machine. The platens are made in two sizes—12″ and 24″ square, for use with lathes from 16″ to 36″ swing, the 24″ platen having a cross-traverse motion of 20″ and a vertical motion of 4″. It is bolted to the carriage of the lathe in the manner shown, and is raised or lowered by means of two screws which are enclosed within cylindrical guides which can be clamped when adjusted to the desired height, making the platen rigid and firm. It can be lifted on or off from the lathe by an eye-bolt placed in the middle of the platen. It will readily be perceived by any machinist that this attachment is capable of doing a wide range of work not easily done by ordinary methods. Centers can be placed on the platen, and, with an arbor for milling cutters in the spindle or on the centers, gears can be cut or other forms of milling done.

It is made by C. K. Bullock, 1357–61 Ridge avenue, Philadelphia, Pa.

The World's Fair.

A special to the New York *Tribune* says: "Up to date 1,700 applications for space for exhibits at the World's Fair have been made, and before the close of the year it is estimated that 200 or 300 additional ones will be sent in. At the Centennial there were on file the January of the year preceding the opening of the Exposition, 800 applications. A somewhat interesting fact in this connection is that, all told, there were 34,000 applications for space at the Centennial. Twenty thousand of these were from foreign countries, and the remaining 14,000 were domestic; but before the opening of the Exposition, 4,000 of the domestic applications were either withdrawn or canceled. All the individual applications thus far received for the Columbian Exposition are domestic.

The study of how and where to feed the crowds at the big fair has been an incident

of the work of the Construction Department for the last six weeks. Food will be served in ten of the principal buildings in restaurants, private dining rooms and over lunch counters. There will be three characteristic lunch counters, twenty-seven principal restaurants or cafés, and, in connection with them, 115 dining rooms. The supplies will issue from seventeen complete hotel kitchens, manned by an army of more than 1,000 waiters, cooks and scullions. The dining-rooms will occupy above five acres of space, and it will be possible for above 3,000 people to sit at the tables at one time.

The committee on awards of the World's Columbian Exposition, after being in session here for several days, adjourned at noon to-day, to meet in Washington on November 23. It was decided to ask Congress for $800,000 to pay for medals and premiums awarded.

A lineman in the employ of a telephone company was recently fined in New York for stringing overhead wires. The defense that the wires did not, and were not intended to carry an electric current, did not avail.

Universal Trimmer.

The engravings represent a universal trimmer for pattern makers' and other wood workers' use, which is so designed that it may be moved about the shop to any convenient location, since the legs do not require to be bolted to the floor. The platen of this machine is 30″ long and 18″ wide, affording an excellent surface plate for building and truing up work upon. The improved arrangement of the frame, knife and gauge will be understood from an inspection of the plan view of the platen, Fig. 2, at the left of which there is a diagram in which *B* represents the gauge, *C* the upright post, *D* the frame and *A* the knife. It will be seen that the knife *A* projects beyond the frame, and as there is no projection at the top of the gauge, the work can be set upright without coming into contact with any projecting part.

The milled slot in the bed guides the gauge, while the upright post takes the full thrust of the knife and gives it a solid bearing which cannot be sprung or broken, the only function of the spring being to return the gauge to a square position when the thumb screw is released. The spring can be detached and the gauge swung around so that the end of the thumb screw can be used for a guide in cutting cants or segment work, in which case the frame makes a shear cut with the knife, as did the gauge before its removal.

There is a screw tapped into the end of the gauge, which comes into contact with the button on the side of the machine, by which the gauge can be adjusted so as to make a perfectly square cut. The button can also be turned out of the way if it is necessary to cut an obtuse angle.

The carriage is provided with oil chambers top and bottom, is strongly ribbed and has a stroke of 12 inches. The shipping weight of the machine is about 300 pounds.

The machine is made by the Fox Machine Co., Grand Rapids, Mich.

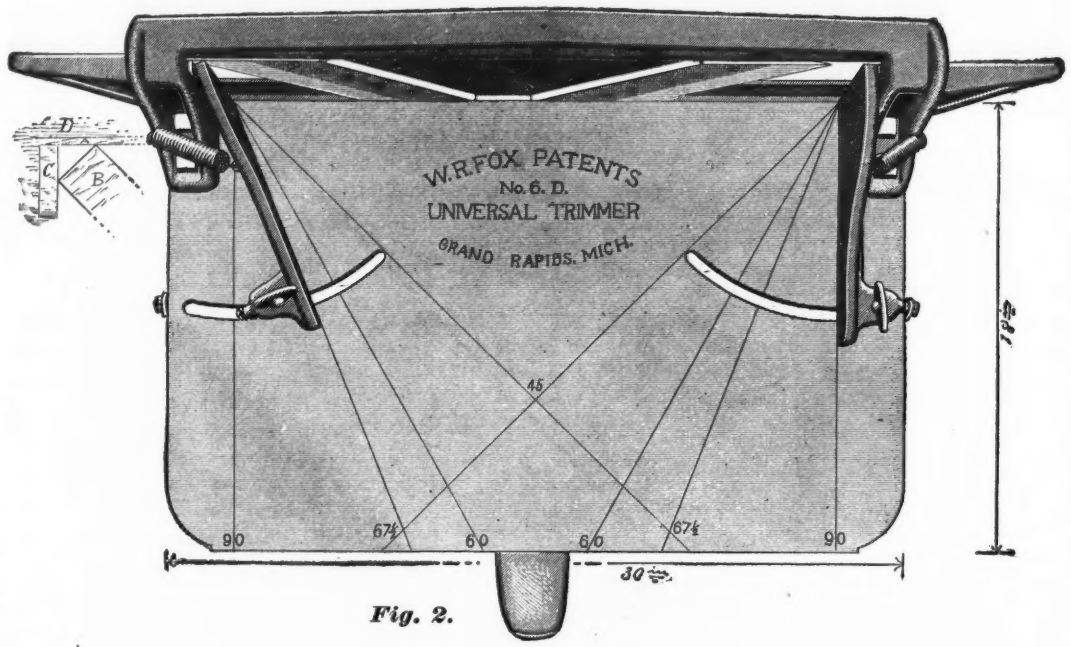
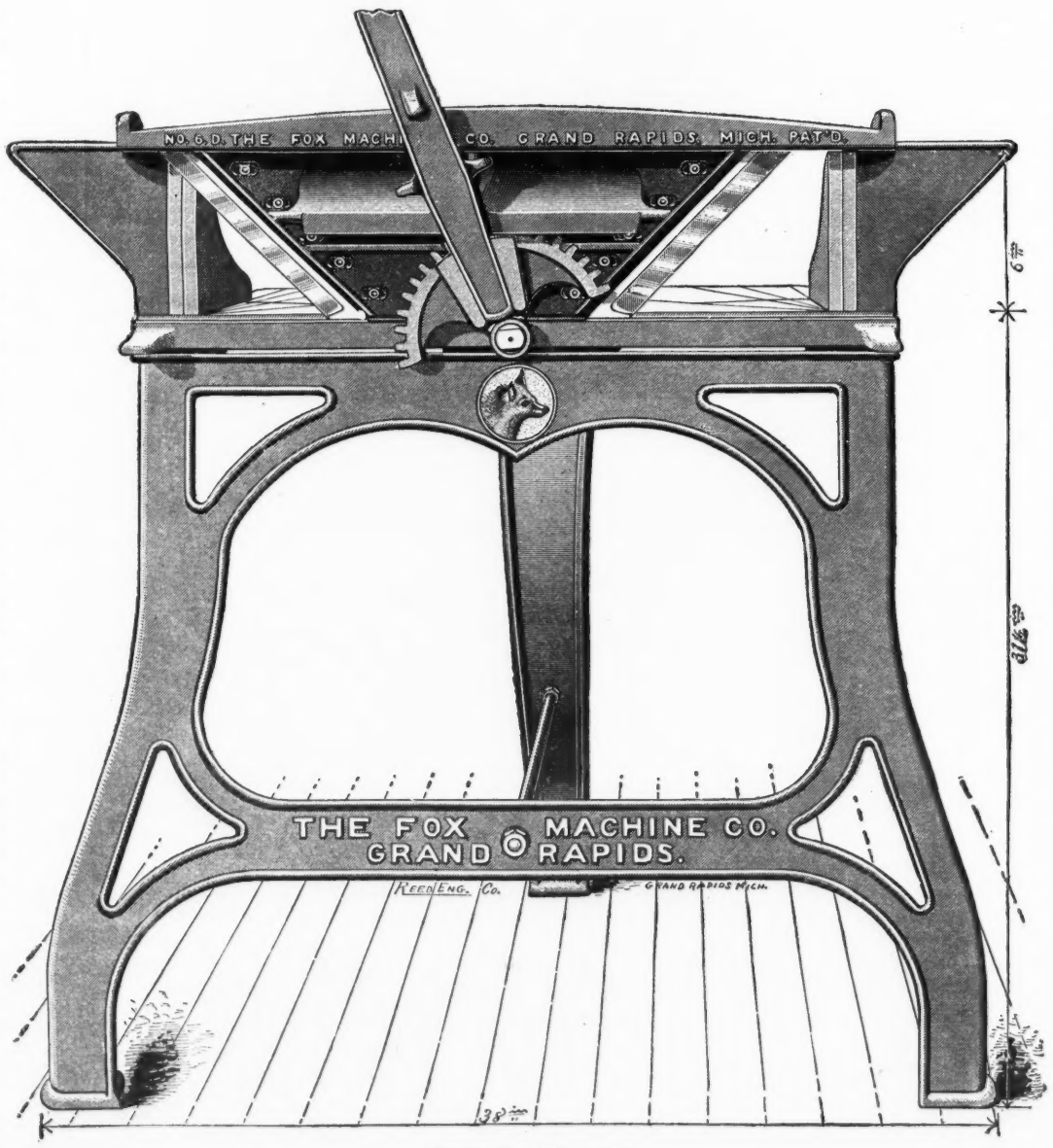


Fig. 2.



UNIVERSAL TRIMMER.

The streets of Helena, Mon., are not exactly paved with gold, nor can one pick up a livelihood in nuggets from the roadway, but cellar digging is apt to uncover enough gold to pay for the labor, and sometimes quite a part of the cost of the house. In digging the foundations of a business block there the interested parties are taking out $100 per day in pay dirt, and do not seem to think it a very remarkable find, either.—*Boston Transcript.*

Progress in Photography.

As an instance of the great progress that has been made in the methods by which rapid movements can be analyzed, the *Photographic News* mentions a series of photographs lately taken by Anchutz, of Lissa, who has already given to the world some of the best instantaneous pictures ever taken. The subject of the pictures at present under consideration is a dog jumping over a small bush. In the act of making one jump, the animal has been photographed twenty-four separate times, and each picture is not a mere silhouette, as was the case with Muybridge's first attempts of this kind, but a little picture showing half tone and detail.

One Hundred and Fifty Ton Steam Traveling Crane.

The crane, of which we give two elevations and a plan, on page 5, is being erected at Woolwich Arsenal. It will lift 150 tons on a span of 65 feet from center to center of the gantry rails. The crab consists of side frames of steel plates and angles, running upon five double-flanged wheels on each side, securely connected together, and carrying the steam engine and gearing for all the movements, with a steam boiler, coal bunker, and feed-water tank, the whole covered by a corrugated iron house with angle-iron framing. The cylinders are 10 inches diameter by 10 inches stroke. The crank-shaft carries three nests of miter wheels, one for each of the movements—hoisting, cross and longitudinal traverse. All the handles for governing the three movements and for changing speeds are brought together to the starting platform, between the cylinders.

THE HOISTING GEAR.

The reversing miter wheels on the crank-shaft have twenty-four teeth, 2¼ inches pitch, 5 inches face, with reversing clutches between them. The horizontal shaft of the center wheel carries a miter wheel of the same size at its other end, actuating a horizontal cross-shaft, which actuates another horizontal shaft parallel to it by three pairs of spur change wheels, all 2 inches pitch and 4 inches face; sixteen teeth and fifty-four teeth for slow speed, twenty-six teeth and forty-four teeth for medium speed, and thirty-two teeth and thirty-eight teeth for quick speed. The last horizontal shaft gives motion to a vertical shaft at each end by miter wheels, twenty teeth 2¼ inches pitch, 4 inches face, and these vertical shafts drive horizontal shafts by similar sized miter wheels. Each horizontal shaft is of steel, and has a worm forged and cut out of the solid on it, which engages into a cast-steel worm-wheel keyed on to a cast-iron chain barrel. The worm is 12 inches diameter to center of teeth and 3½ inches pitch, and works in an oil bath. The thrust is taken by a hardened steel lens at the end of the shaft, bearing against a strong provision made to receive it at the end of the framing. The reaction in lowering is taken by an ordinary wide collar against the bearing brass. There are two cast-iron grooved hoisting barrels, each 4 feet diameter to the center of chain and about 4 feet long, and each has a cast-steel worm-wheel keyed on one end, having seventy teeth 3½ inches pitch, 7½ inches face, 78 inches diameter. Each barrel is keyed on a steel shaft which runs in a bearing at each end, bolted on the side frames. The hoisting chain is 1¾ inches diameter, passes over four sheaves in the falling block, and three sheaves suspended from a strong box girder between the side frames, and has the ends fastened to the two barrels.

The falling block consists of two sides or cheeks of 1½ inch thick steel plates, through which the gudgeons pass; four cast-iron grooved chain sheaves, 3 feet diameter to center of chain, bushed with gun metal, and running upon a forged steel axle passing through the side plate; and of a bottom shaft or crosshead, similarly supported in the side plates, and from which the ram's horn hook is suspended on a live roller bearing, consisting of a number of balls running in three grooves in the top and bottom plates. The three top sheaves are like those in the falling block, and run on a steel axle suspended by two wrought-iron slings from a crosshead, which hangs by a steel bolt from a box girder of steel plates and angles extending between the side frames. This top sheave block is free to revolve on a live roller bearing similar to the one for the ram's horn hook.

The cross traverse gear consists of a nest of miter wheels on the crank-shaft, with clutches for reversing, twenty teeth, 2¼ inches pitch, 4 inches face, actuating a vertical shaft, which drives a horizontal cross-shaft at its lower end by a pair of bevel wheels with eighteen and twenty-six teeth, 2¼ inches pitch, 4 inches face. This shaft drives another horizontal shaft by a similar pair of bevel wheels, which has two worms forged on it, with worms cut out of the solid gearing into cast-steel worm-wheels keyed onto two of the axles of the running wheels, which are carried across, having a wheel keyed on each end. Each worm-wheel has thirty-six teeth, 2¼ inches pitch,

4 inches' face, and the worm has a single thread.

The longitudinal traverse gear consists of a set of miter wheels and clutches on the crank-shaft, like those for the cross traverse, giving motion to a horizontal shaft, which drives another parallel horizontal shaft by two pairs of spur wheels for change of speed, having eighteen and eighteen teeth and twelve and twenty-four teeth respectively, 2 inches pitch, 4 inches face. This second shaft drives a horizontal cross-shaft by a pair of bevel wheels, having twenty and twenty-six teeth, 2¼ inches pitch, 4 inches face. This latter shaft drives a vertical shaft on one side of the crab, and through it a horizontal square shaft, resting in tumbler bearings on the traveler girders, by means of two pairs of bevel wheels like the last, having twenty and twenty-six teeth. At each end this square shaft drives a vertical shaft on the end carriage by a pair of bevel wheels having twelve and thirty-six teeth, 2¼ inches pitch, 4 inches face. Each vertical shaft drives a horizontal shalft, crossing the ends of four wheel axles at the height of their center line, by a pair of bevel wheels having twelve and twenty-four teeth, 2½ inches pitch, 5 inches face. This horizontal shaft drives four running wheels by bevel wheels having twelve and thirty-six teeth, 2½ inches pitch, 4 inches face, the 36-tooth wheels being keyed onto the axles of the running wheels. Thus four wheels in each end carriage are geared for the longitudinal traverse.

The crab sides are made of ½-inch steel plates, framed together with 3-inch by 3-inch by ½-inch angle steels, and stiffened where necessary, and firmly framed together crosswise. Each side frame rests on five double-flanged cast-steel running wheels, 2 feet 6 inches diameter on the tread, forced or keyed onto their axles. The two wheels at the heavy end of the crab on each side are fixed on axles common to both sides, so as to have four wheels geared up for the traverse. All the other wheels have short axles. Each wheel has a bearing on each side for the axle to run in. These bearings consist of a top brass in a cast-iron axle-box, with a lubricating sponge-box kept up to the bearing with a key underneath.

A platform is formed round the crab, and the whole surmounted with a house, framed with angle-iron and covered with corrugated sheets, as shown. The platform is strong enough to carry the boiler on one side, with a coal-bunker in the corner, and the feed-water tank on the opposite side.

The boiler is of the cylindrical horizontal marine return-tube type, 5 feet 6 inches diameter, 9 feet 6 inches long, all steel, except the tubes, which are wrought-iron. The shell is $\frac{5}{16}$ inch thick, with double-riveted lap joints for longitudinal seams, elsewhere single-riveted; ends ½ inch thick, each in one plate; flue, 2 feet 9 inches diameter, $\frac{7}{16}$ inch thick; fire-box, ½ inch thick; 116 tubes 2 inches diameter by 8 feet long. The fire-box and ends are efficiently stayed with screw and gusset stays in the usual manner, suitable for 100 pounds working pressure, although the ordinary working pressure is to be only 80 pounds. The total heating surface is 560 square feet. A sheet-iron smoke-box with a hinged door, surmounted by a short chimney, is fitted to the front end of the boiler, as shown. The boiler is fitted with all the usual mountings, including feed donkey pump, and lagged with Leroy's non conducting composition. A coal-box is fitted near the front of the boiler to contain one ton of coals, or sufficient for twenty-four hours' consumption in ordinary work. A feed-water tank is placed on the platform on the opposite side of the crab to the boiler, to contain 65 cubic feet of water, or sufficient for six hours' ordinary work. The main girders are of the box section, made of steel plates and angles 7 feet 6 inches deep by 2 feet 5 inches broad over flanges; the top is level, and the underside fish bellied, the ends which rest on the end carriages being 2 feet 8 inches deep. Each of the flanges is made of two plates ½ inch thick, extending about 20 feet either side of the center, beyond that of one plate only, and two angles 4½ inches by 4½ inches by ⅝ inch; the webs are $\frac{7}{16}$ inch thick, butt-jointed, the joints being covered by flat bars 6 inches by ½ inch on outside, and 6 inch by 3-inch T-steels inside, each T-steel flange, and $\frac{7}{16}$-inch webs and 6 inch by 3-inch by ½-inch T stiffeners. The lower girder consists of two separate girders connected together at ends and between the wheels, each made of ⅝-inch web plate, and two angles 3 inches by 3 inches by ⅝ inch top and bottom.

The wheels are of cast-steel, double flanged, and 2 feet 6 inches diameter on the tread. Each is forced on to a short steel axle running in an axle-box bearing on either side, similar to those of the crab. Four of the axles in each end carriage are lengthened to carry the bevel wheels already described in the longitudinal traverse gear. The wheel base of each end carriage is about 21 feet, and the length of the carriage over all about 24 feet.

The speeds provided are as follows: Hoisting, 2 feet per minute for 150 tons, and 4 feet and 6 feet per minute for lighter loads. Cross traverse, 15 feet per minute. Longitudinal traverse, 15 feet per minute for full load, and 30 feet per minute for lighter loads.

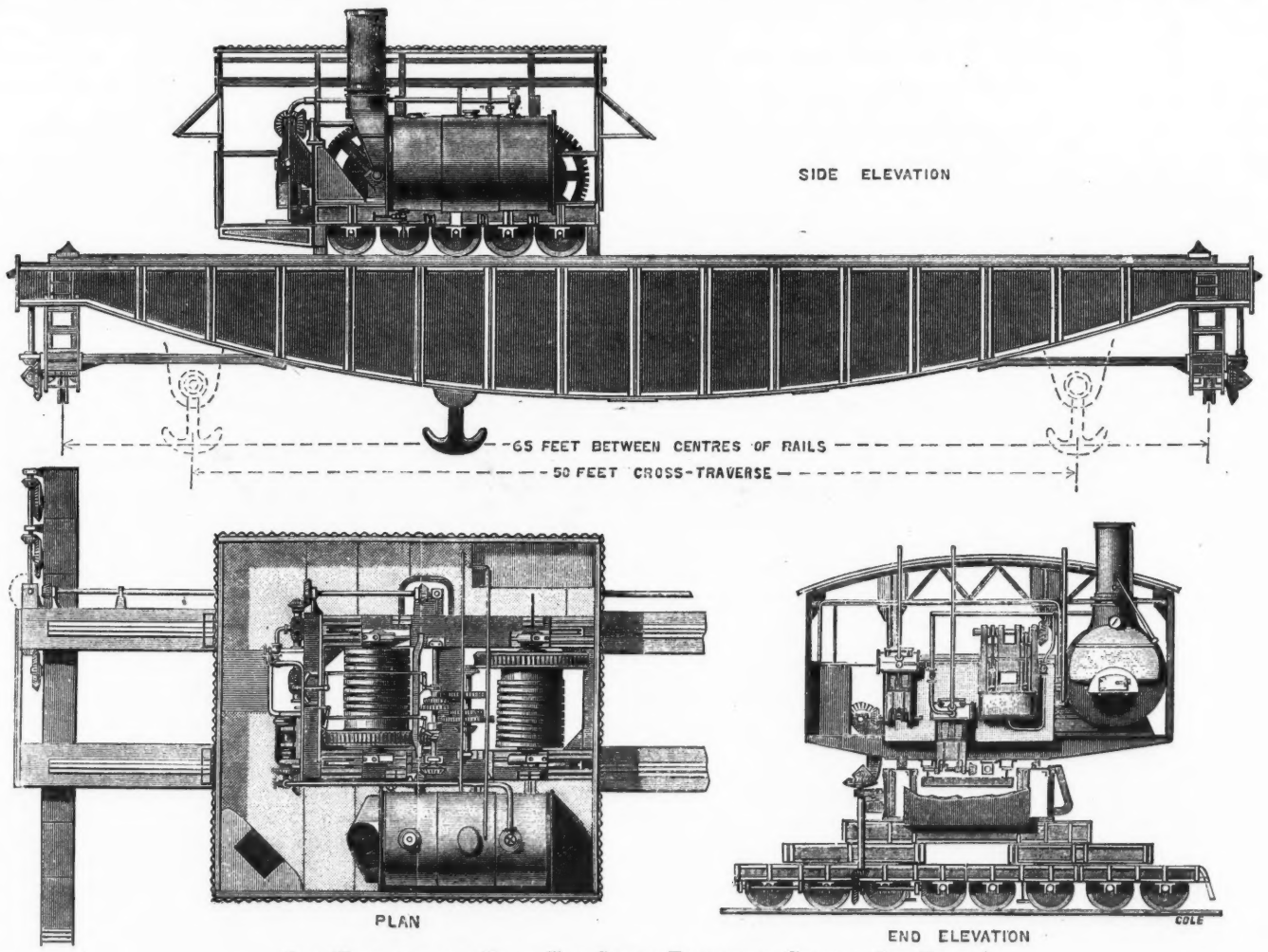
The maximum range of lift is from 3 feet to 24 feet from the ground to the bottom of the hook, with the top of the gantry rails 26 feet above ground, giving a lift of 21 feet. The maximum cross traverse is 54 feet.

Generally the bearings have all brass linings, and suitable lubrication is provided throughout. Ladders are fitted where necessary, to give access to the several parts of the traveler. All rivet holes are drilled. All gearing and running wheels are of cast-steel, and shafts of forged steel.

TESTS.

The plates and bars are of mild steel, with a tensile strength of not less than twenty-eight tons per square inch, an elongation of not less than 20 per cent., and a contraction of area of 40 per cent. The boiler was tested to 150 pounds per square inch by hydraulic pressure.

We are indebted for the illustrations and description to our esteemed contemporary, *The Engineer*, London.



ONE HUNDRED AND FIFTY TON STEAM TRAVELING CRANE.—SEE PAGE 4.

The September statement of the Central Railroad of New Jersey shows net earnings of $529,030—a decrease of $25,743 from the corresponding month of last year. The net earnings from January 1 to September 30 were $4,387,744—an increase of $231,534 over the same time last year.

LETTERS FROM PRACTICAL MEN.

Piece-work.

Editor American Machinist:

I have been very much interested in the articles and discussions that have lately appeared in your paper for and against piece-work. I must confess I fail to understand how any one can claim that by day-work he can produce better work, or compete with their more enterprising neighbors who have adopted piece-work.

In your issue of Sept. 3d, Mr. Cairns takes the ground that piece-work is unfair to the good workman. He takes foundry work to prove his statements. Now, any one that knows anything about molding or foundry work knows that there can be nothing more unfair to a good molder than to have a fixed price per day for each man, the good and the poor alike. This may not be the case in some foundries, but I know some proprietors tell their foremen the amount of pay their men must receive, taking it for granted that one man ought to be as good as another, and capable of doing any job that comes into the shop.

In your issue of Aug. 6th Mr. Wathey makes a good point when he says that piece-work will bring out the best qualities of the men; this is certainly true, for it gives the good workman what he is worth; it gives to the ambitious and those that are not afraid of doing too much work a chance to be something more than common workmen. To the poor workman it does no injustice; he receives pay for what he does, and has no cause to complain.

Mr. Cairns takes up this point and tries to prove it is just the reverse; that the poor workman gets the best of it. One illustration he gives is, that a first-class molder gets a steam cylinder to make. It is a fair day's work, and he gets $3 for it. A poor hand gets grate bars to make; he gets 30 cents a flask with two patterns in it; he makes ten flasks a day, and gets his $3. He then goes on to say that there is ten times more labor in making ten flasks of grate bars than in making the cylinder, and ten times more skill in making the cylinder than in making the grate bars. I see no injustice in this. The good molder has the best of it. The objection of Mr. Cairns is, the poor molder, by working hard, receives as much pay as the good workman does who takes his time, and manages to get in a full day on the cylinder. I suppose if the poor workman had worked all day and made five flasks of grate bars, and received $1.50 for it, he would think that it was right.

He then takes stove plate work. I would enjoy seeing Mr. Cairns run a stove plate shop on day-work. I think he would have a hard time to sell his stoves at a profit. It would double the price of stoves, and not give so good a stove. There is nothing will make a man so careful as to take his lost work out of his own pocket. It will make him more thoughtful, and in looking after his own interest it helps his employers. How many times I have seen a molder lose everything he made for two or three days, and if on pay day there should be a mistake in his pay, how quick he would speak of it,

forgetting how many times he had been paid for lost work.

We will take the clerks in our stores; each one tries to outsell the other; they never think they are ruining the business; they know that only by hard work they can build up the business; these are the men that succeed in life; they have something to look forward to. Some day they will be in business for themselves. How many molders do we see that will ever be in business for themselves? Not many. Yet once in a while we see one, and if you could follow that man's life from the day he came into the shop until he owned one himself, you would find he never set his day's work by what his neighbor did. He did not stop to tell some story of a big piece he made once; his place was on his own floor, and there you were sure to find him. In speaking of him people say he is lucky. It is not luck; it is energy and push which raised him above a common workman, and years afterwards he can look back and see one who came into the shop before he did, plodding along, thinking only to have pay day come, and grumbling because some one else is getting rich, while he gets only a living. These are the kind that always say so many flasks are a day's work, and he could always manage to get his time in on them, and when some one with a little vim was put on this job, and did one-third more, and did it easier, he was accused of trying to ruin the business. I have heard these same arguments brought up a great many times in the last twenty years.

It is the men that are afraid of doing a fair day's work that are ruining the business; they are the ones that compel the proprietors to adopt piece-work, because they will not work as they have been paid for doing. Every man knows when he leaves the shop at night whether he has done what is right or not; it will not be necessary for his foreman to tell him that he has been paid to work ten hours and has only worked nine hours.

By piece-work we have no trouble of this kind; every man gets paid for every perfect casting he makes; he expects nothing for bad work, and takes greater pains to turn out only good work, knowing it is for his own interest, as well as that of his employers.

JUSTICE.

Vise Suggestions.

Editor American Machinist:

Noting the limited clamping effect in the ordinary vise, I have made a calculation of the power developed by the screw as follows. The proportions are purely hypothetical, and not those of any vise made, to my knowledge:

The screw *D* in Fig. 1, if it has three threads to an inch and its mean diameter is one inch, has power the same as a wedge nine and forty-two hundredth inches long and one inch thick at the head. That is, it multiplies power nine and forty-two hundredth times, less friction. Then if the lever *C* be twelve inches long from the center of the screw, it is equal to twenty-four radii of the screw, and has power as twenty-four to one. Therefore the power developable in the screw is

$$24 \times 9.42 = 226.08.$$

Discarding the fraction, it is evident that a man exerting two hundred pounds of force at the end of the lever *C* should, if there were no friction, clamp a piece within the jaws of the vise by a pressure equal to forty-five thousand two hundred pounds! More than twenty-two and one-half tons!

Every person who uses a vise knows, of course, that no such pressure is ever produced between the jaws of any one ever made, and that no vise made would be strong enough to stand such pressure if it were produced. He knows also that the loss is due to friction.

The friction that exists at any time in a vise may easily be found, thus: It is evident that the pressure between the jaws would reverse the screw and relieve itself if it were not for the friction in the different parts of the screw. It is evident also that this pressure is equal to the force multiplied from the lever, less this friction, and that the friction at the first moment of reversal is practically equal to the friction at the last moment of forward effort.

The force required to start open a vise at the first moment of such start must be equal to the force consumed in friction at the last moment of the effort to clamp. And the whole force required to release a piece is equal to the power lost in friction in clamping that piece, less such friction as may have been produced in resistance to work accomplished. Work accomplished is such as squeezing a piece of lead thinner or forcing a drift through a hole.

Now, if a piece be placed within the jaws of a vise having the proportions described above, and arranged so that when it is clamped the lever will lie horizontally, then if a weight of two hundred pounds be hung on the end of this lever, and such weight be permitted to tighten the vise, we know that there is a pressure of forty-five thousand two hundred pounds, less the friction, on the piece between the jaws.

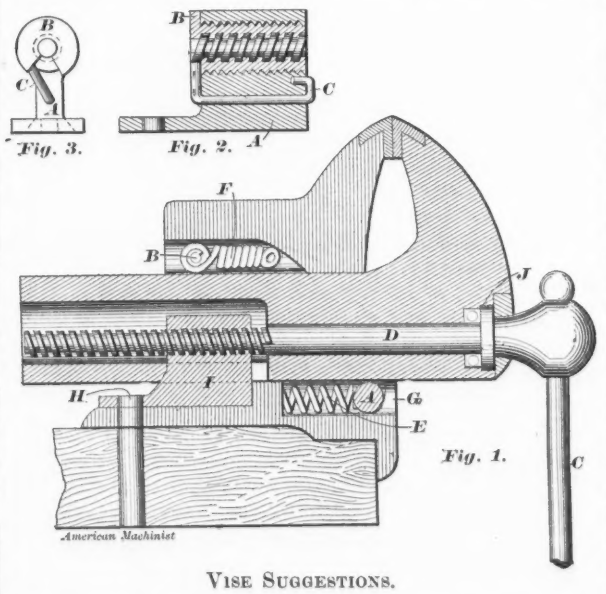
To weigh this friction we have but to slide the lever through to the other side, and hang on such weight as may be necessary to release the screw. If this weight be one hundred and eighty pounds, then nine-tenths of the force has been lost in friction, and the pressure on the piece within the jaws is only four thousand five hundred and twenty pounds, or about two gross tons. If it takes any other weight to release the vise, the friction may be found in the same way.

It is well known that the bench vise has more friction than the standing vise, because it has large sliding surfaces, while the standing vise is hinged at a distance from the screw.

In the vise shown in the sketch the friction rolls *A* and *B* are each held back against shoulders by the springs *E* and *F*. These springs are just stiff enough, so that the ordinary sliding movements of the front jaw will not disturb them. Each has room to move two inches with the slide.

When the jaws come together, as in the sketch, or with a piece between them, the moment a clamping strain is put on the screw the leverage places all the sliding friction on these two rollers, and they will move with the slide just one-half as fast as the slide moves. This changes the sliding friction to a rolling friction, and will, I believe, give results equal to the old standing vise in that particular.

When the strain in the screw is released



VISE SUGGESTIONS.

the springs will return the friction rolls to their first positions.

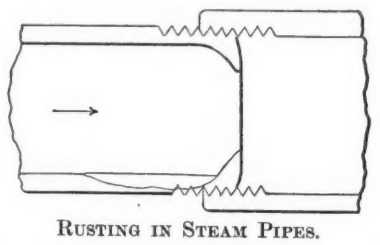
The remaining friction is on the screw, within the nut *I*, and at the pushing shoulder *J*. To relieve this last friction I place hardened balls under the shoulder *J*. This is probably all that can be done with that shoulder. These balls are held between concave hardened washers, as shown.

In vises where the nuts are dovetailed into the stock-piece I have noticed that such nuts get loose and bind the screw. To obviate this I have here indicated a way they may may be bolted down with the stock-piece, in addition to the dovetailing. The bolt head lies on the extension *H* of the nut *I*, and passes through the bench, and, as usual, has a nut and washer beneath.

It is evident that all the friction that can *practically* be taken from this vise thus is removed—I estimate it about half—and while one-half still remains, it does not seem advisable to tamper with the nut. Yet Fig. 2 shows a differential nut, which might operate well.

In Fig. 2 is shown the nut *A*, having the internal nut *B* and a torsional spring *C*. If the thread within the nut *B* be three to the inch, and if the thread outside of it be nine to the inch, then their powers are, of course, three to one.

The spring *C* is a stiff one, and can only be sprung by considerable force, and it permits the nut *B* to make a quarter turn in



RUSTING IN STEAM PIPES.

the nut *A*. Under a great strain the friction within the inner nut is strong enough to turn that nut and overcome this spring. This probably always would be done at the moment of final strain, and it would multiply the power at that point by three, less the force of the spring. Of course, when the screw is reversed, the force of the spring and the friction combined would bring this nut back against its shoulder.

My purpose in all this description is to show where there is a great loss, and to indicate the remedy that is suggested to me by a long practical experience. The remedy I show is not the only one, and probably is not the best one, but it is a remedy of some kind and a practical one, as far as it is recommended and shown in Fig. 1.

A. D. PENTZ.

Peculiar Rusting in Steam Pipes—New Pipe Cutter Wanted.

Editor American Machinist:

It is infrequent that wrought-iron steam pipes are affected with internal rust, that is, those which are well drained and in constant use. It has been a surprise to me that during the past year I have had to repair as many as a dozen places in a single line about eight hundred feet long. The pressure in this pipe is reduced to fifteen pounds, and steam is only used during the heating season—say from September to May. This line was erected some ten years ago by myself, and care was taken that it was put up straight, with a uniform downward pitch of five inches in every hundred feet. These leaks appear as shown in sketch, and are probably due to the burr turned up on the inside of the pipe by the disk or wheel pipe cutter, as they are all on the bottom and on the side from which the steam comes. When the steam is on, it is not likely that there is much active corrosion, but when the pipe is out of use, little pools collect in all these places, and get in their work during the summer; and when steam is turned on again it loosens the scab of rust and leaves the raw iron exposed for further corrosion. From an examination made at some joints where there has not as yet been any leak, I have good reasons to expect a prosperous winter in the repair line.

Now will somebody invent a pipe cutter that will cut the ends off square and leave the pipe straight and clean? The roller cutter fixes the outside all right, so that dies catch without filing off the burr, but that does not help the inside, which is left with this circular dam, that not only induces the trouble I have referred to, but it reduces the effective area of the pipe and increases the friction of flowing liquids or gases.

PETER H. BULLOCH

Cores and Core Makers.

Editor American Machinist:

The engravings of Rollanson Gas Engine, illustrated in your paper Sept. 17, page 2, Fig. 3, show the cores in the combustion chamber, and as I had the pleasure of seeing that work done, I would like to say a few words on the construction of the cores, as they all are shown in Fig. 3, except one, which shows that core making is almost a trade by itself. The core *c* is a common core, but the jacket *A* and *B* are peculiar cores, surrounded by $\frac{1}{2}''$ of iron, and with only 4 places to fasten and let the air off, as everything is plugged up when finished. The one core not shown is also a very peculiar one, and a very nice job to see it and get the air off. Any one who looks at the engraving, Fig. 3, can imagine that it is a very nice piece of core work; but as the core boxes were devised and made by a very skillful and practical pattern maker, it was a great benefit and help to the molder. None of these cores except the center one were over $\frac{1}{2}''$ thick, and the metal not over $\frac{3}{8}''$ surrounding it, and as every jacket was put under high pressure, very good and sound castings were necessary, and it was well understood that nothing else would be accepted. Skill and forethought were required to fulfill the conditions, and they were filled with good satisfaction. Molding the combustion chamber of the engine was very simple, as the cores were all fastened together on one core, and that was so constructed that the molder could not put the core wrong in the mold, and everything came easily as it required, and I can say it was a very nice piece of work. When the pattern maker brought the pattern and the core boxes to the foundry, I said they were very crooked cores. He said, "Well, they were made in England." "Well," I said, "if they made them in England they can be made in America," and so they were, and gave good satisfaction. The whole job shows, I think, how important it is that molders should thoroughly master the art of core making—an art which unquestionably few of them ever do thoroughly master.

VALENTINE GEISELHART.

Banking Fires.

Editor American Machinist:

Is there any economy in banking the fire under a steam boiler over night? The above question has been having somewhat of an airing of late, without any definite conclusions. Some engineers habitually and systematically practice banking, without any consideration as to economy, while others persist in doing so for convenience. It must be admitted that it is very convenient to have a little fire in the furnace of mornings, especially when the fireman is late to his work.

I have heard men say that it is cheaper to purchase kindling wood for the purpose of starting a fresh fire each morning than to use coal to bank the fire with. While I have curious doubts of the economy of this plan, still a great deal depends upon circumstances. I have run steam plants where eight scoopsful of coal—very small scoops, too—would bank two fires in a single furnace under two boilers. The working pressure was 60 to 65 pounds. On entering the boiler room of mornings there would seldom be less than 35 pounds pressure. Uncover, break up, and spread the fire, throw two or three scoopsful of coal in each of the three doors, then by the time three or four oil cups were filled, and other little necessaries attended to, there would be sufficient steam to start the work. I have many times performed this, and had the work going within fifteen minutes from the time I entered the boiler room. Quite convenient, you see, when the fireman is late; and I don't believe that bought kindling wood could economize much in such cases, for the simple reason

that the banked fire maintained a little pressure through the night, where, without the banked fire, there would have been no pressure.

One filling up of coal banked the fire; another filling up of coal in the morning, and in less than ten minutes sufficient pressure for all purposes. Without a banked fire at least two fillings of coal will be required, possibly three.

I have known men to manage their furnaces in a most wasteful and reckless manner, and bank their fires at the same time; but this was for convenience sake. They banked their fires all right, but left the furnace doors open, with the draught on. This practice is an injury to the boilers, and is wasteful to the extent of the fuel required to replace the heat carried up the smoke stack during the night. To bank a fire successfully, the following must be observed: see that the draught is entirely removed from the boiler by closing a good, tight damper, and, to make sure of this, open the smoke box doors; bank the fire with fine coal—the finer the coal the less coal is required; and also less covering is required to keep it from breaking out. Close the ash pit doors, also the furnace doors, and dampen the ashes a little, that are to be used in covering the banked fire, with water.

I have used sheet-iron caps with success for flue boilers; cut a round cap for each flue that will just fit inside the flue at front end, rivet a handle on each cap, and after banking the fire place them in the ends of the flues. Or if a tubular boiler, make one cap for each boiler in size to fit over the entire tube area, and brace it hard against the tubes, thus making doubly sure that no draught will pass through the boiler.

S. A. SMITH.

Efficiency of Non-condensing Compound Engines.

Editor American Machinist:

In a recent issue of your paper, "Critic" reprints an item from the London *Engineering* on the above subject, and propounds with it a series of questions which are to be commended for their directness. A suitable answer to these questions would be of great service to your readers, and I only regret that time on my part, and space on yours, does not permit of opening them as fully as they deserve.

For convenience, I repeat the article from *Engineering* referred to, and as under the questions of "Critic" it separates itself into two statements, I would indicate them by paragraphs (*a*) and (*b*).

Engineering says: "(*a*) Non-condensing compounds are built, but do not as yet give great satisfaction unless carefully designed for a constant load. With variable loads, where the variation is great, they are of little value; until higher pressures become more common they are impracticable under such conditions; and

(*b*) With good loads, such as to maintain constantly about six expansions, and 120 pounds boiler pressure, these engines have about the same economy as simple Corliss non-condensing engines with 80 pounds boiler pressure."

I further repeat "Critic's" questions *seriatim*, and beg his pardon for answering them dogmatically.

"*First.* Is it true?" (*a*) Yes, in England; and until within three years in this country. (*b*) No.

"*Second.* If so, why is it true?" (*a*) As briefly as possible, because the compound engine, non condensing, at its best performance will exhaust from the low-pressure cylinder at a pressure 2 to 6 pounds above atmosphere, and somewhere within the power corresponding to these limits the engine will be rated. Such an engine will be limited in its economy to a very short range of power, for the reason that its valve motion will not permit of any great increase beyond its rated power, and any material decrease below its rated power at once brings the expansion curve in the low-pressure cylinder below atmosphere. In other words, decrease of load tells upon the compound engine somewhat sooner, and much more severely, than upon the non-compound engine. The loss commences the moment the expansion line crosses the atmospheric line, or, more strictly, the moment it crosses a line parallel to the atmospheric line, and at a distance above it representing the mean effective pressure necessary to carry the frictional load of the engine. When expansion falls to this point, the low-pressure cylinder becomes an air-pump over more or less of its stroke, the power to drive which must come from the high-pressure cylinder alone. Under the light loads common in many industries, the low-pressure cylinder is thus a positive resistance for the greater portion of its stroke. This will be made very clear by Fig. 1, which is a diagram taken with a 10-pound spring from the low-pressure cylinder of a Corliss cross-compound non-condensing engine. Steam was cut off at the point *A*, and at once expanded to a negative terminal pressure of 8 pounds below atmosphere at *B;* in other words, there was a vacuum of 8 pounds in the cylinder at the moment of exhaust. When the exhaust valve opened, an inrush of air took place, and the weight and velocity of air in the long exhaust pipe caused a back pressure due to its momentum, amounting to a maximum of 4½ pounds above atmosphere at *C*, the rebound of which carried the line again below atmosphere at *D*.

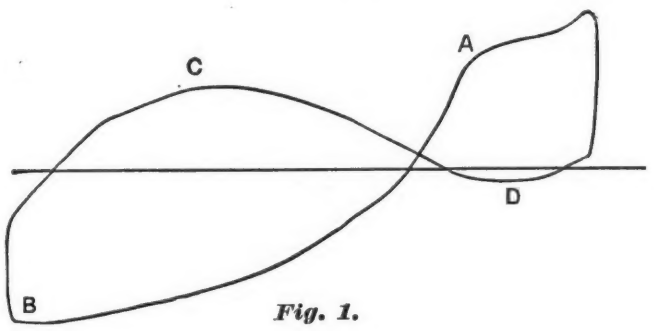


Fig. 1.

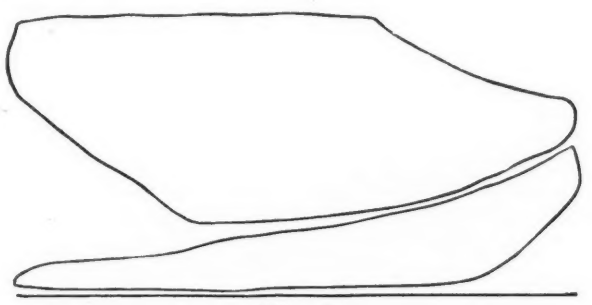


Fig. 2.

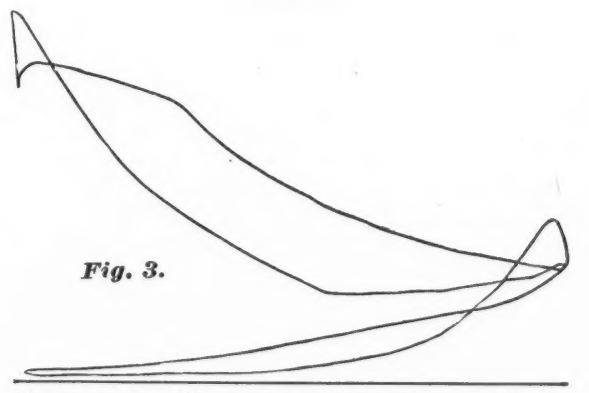


Fig. 3.

EFFICIENCY OF NON-CONDENSING COMPOUND ENGINES.

It will be seen that the expansion line crosses the atmospheric line at a point representing $\frac{5}{10}$ of the stroke. The motive value of the low-pressure cylinder is represented by the area *A D*, equivalent in this engine to 50.4 H. P., and operating through $\frac{9}{10}$ of the stroke. For the remaining $\frac{1}{10}$ of the stroke, the low-pressure cylinder was dragged against an average vacuum of 5½ pounds, and returned against an average back pressure of 3 pounds, representing a total resistance of 170.5 H. P. The net result of the low-pressure cylinder was, therefore, 50.4—170.5 H. P., or a dead load within the engine itself of 120.1 H. P. What rational manufacturer would think of running an engine with 120 H. P. constantly applied to a brake on the band wheel? Yet this is precisely what was done in this case. Or, to put it still more forcibly, the high-pressure cylinder was developing 186 H. P., of which 120 H. P. was used up in dragging the low-pressure piston against a vacuum, and 66 H. P. was left for useful work, at the cost of a net fuel consumption far worse than the rudest full-stroke engine of fifty years ago. (It is proper to state that this engine was designed to ultimately drive a much heavier load.)

"*Third.* Have any experimental data on the subject been published?" So far as I am aware, nothing has been published bearing upon this subject until a recent pamphlet entitled "Notes on Power Plants," issued by the concern of which I am a member. Builders of high speed compound engines in this country, knowing of the facts above indicated, have naturally not been anxious to give them wide publicity. On our own part, we have refrained from claiming too much for the results of our design until it was definitely settled under conditions of practice, such as are brought in by electric railways and the like.

"*Fourth.* Is it necessarily true in the nature of things, or is there no remedy?" It was a part of the writer's experience, some five years ago, to be connected with the original design of a compound engine in which the above problem was fully discussed. It was foreseen that a compound engine in moderate and small sizes, to be commercially successful must possess two features. The vast majority of users of engines are without sufficient water for condensation, and a compound engine must, therefore, be independent of a condenser in securing its full relative economy. Again, many lines of ordinary manufacture, such as relays to water power, electric lighting, and, notably, street railway service, involve widely varying loads, and a non-condensing compound must consequently be able to meet the extreme of light loads, even down to the friction of the engine, with practically undiminished economy. This is simply saying that the expansion in the low-pressure cylinder must not fall below atmosphere under the lightest loads. A careful study of this problem revealed the functions of a fixed intermediate clearance, always in communication with the high-pressure cylinder, and having a volume bearing the same ratio to that of the high-pressure cylinder that the high-pressure cylinder bears to the low-pressure. Diagrams were laid out on this principle and justified until the best theoretical results were obtained. The designs were then laid down on these lines, and the subsequent performance of the engines, of which some 600 have been built, have fully confirmed the judgment of the designers.

The effect of this constant clearance is to supply sufficient steam to the low-pressure cylinder under light loads to hold its expansion curve up to atmosphere, and at the same time leave a sufficient clearance volume in the high-pressure cylinder to permit of governing the engine on its compression under light loads. The engines thus constructed are found to be as perfect in regulation as it is possible for any steam engine to be, and Figs. 2 and 3 will indicate to the engineer how closely the fundamental theory has been carried out in practice. A recent test on an engine of this type, of nominally 150 H. P., showed the following duty in pounds of steam condensed from the exhaust over a variation of load ranging from 50 to 210 H. P.:

50 horse-power.	28.8 pounds.
80 "	24.6 "
100 "	22.4 "
115 "	22.2 "
140 "	22.2 "
170 "	21.9 "
210 "	22.6 "

Steam pressure carried was 120 pounds, and all the steam passing through the engine, including entrainment, was condensed in a surface condenser and charged against the engine. The performance over so wide a range of load is remarkable in the light of foregoing practice. When it is remembered that the best recorded performance of Corliss non-compound non-condensing engines ranges from 26 to 32 pounds when in good condition, the above facts would seem to fully answer the statements made in *Engineering*.

WM. LEE CHURCH.

Trial Trip of the Ferryboat "Cincinnati."

The double-deck screw propeller ferryboat "Cincinnati," of which we have given an illustrated description in our issue of November 12, made her final trial trip on the 7th inst. Her appearance and performance elicited the highest praise from the numerous invited guests, among whom were many prominent marine and mechanical engineers. Her steering and maneuvering powers are all that can be desired, and the ventilating system, as well as the electric light plant, worked excellently.

The main engines worked equally satisfactorily, and caused scarcely any tremor in either the lower or upper cabins. The successful effort of the Pennsylvania R. R. in providing safe and comfortable transit across the river will certainly be appreciated by its many patrons.

The boat started from Jersey City, ran to the Brooklyn Bridge, and returned to the slip of the Cortlandt street ferry house, showing the ease with which a landing could be made, and then proceeded up the Hudson. The trip, of about four hours duration, was enjoyed by all, and the luncheon gave ample evidence of the liberality of the Pennsylvania R. R.

Infringing on an Ancient Idea.

"There is no new thing under the sun." Messrs. Roberson, of Long Acre, in the course of their business of supplying artists with pigments, become possessed from time to time of remains of the great Egyptians, to be in due course ground up by them, and sold in tubes as "mummy" paint. The firm recently lent a piece of the beautifully woven and preserved linen bandages, in which a high priest and keeper of the baths had been preserved, to be shown at some conversazione or lecture in the Midlands.

The texture and quality excited great admiration among the audience, which culminated in something like astonishment upon the declaration of a manufacturer that this fabric, woven perhaps by a contemporary of Moses, contained the same disposition of threads which he had independently invented and patented only a year ago.—*Pall Mall Gazette.*

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An Expensive Kind of Friction.

Most mechanics understand perfectly well that friction is a thing that is to be avoided so far as possible, and they will always take considerable pains to get rid of it so far as may be. But there is one kind of friction often found in machine shops, which the mechanics in charge of those shops do not seem to fully understand the importance of getting rid of, and which is, therefore, allowed to continue, to the detriment of the work, and to the injury of the business. We refer to friction between men connected with the shop in one capacity or another. This may be, and often is, the most expensive and the most disastrous friction which can be allowed to exist in a shop, and it should be the especial object of every one who is responsible for the management of a shop to see to it, if possible, that no friction of that kind is developed, or, if developed, that it be removed as soon as practicable.

Two men working side by side in a shop, who for any reason fail to agree fairly well, will neither of them do as much work nor as good work as if they do agree and are ready to help instead of to hinder each other at every opportunity. Such friction as this is especially injurious when it exists between the body of men in the shop, and some one man with whom they are thrown continually into contact. Suppose it to be the man who is in charge of the tool room, for instance. If for any reason the men in the shop, or any considerable part of them, are "down on him," it results in friction which will cost the proprietor dearly, unless it is promptly removed. For in such a case, each side is very apt to be looking all the time for an opportunity to get the other into some difficulty, instead of working together for the avoidance and prevention of difficulties so far as practicable. If the tool room man sees that some of the work in the shop is not going as it ought, then, instead of going frankly to the person responsible for it, and calling his attention to it, as he would if on friendly terms with him, he "lays low" and chuckles over it, and calls the attention of his friends or "his crowd" to the "hole that fellow is getting himself into," and if it turns out to be a real blunder, the total cost of that blunder to the proprietor is not alone what such a mistake should cost, but something additional to cover the time spent in discussing it, and chuckling over it. The men in the shop return the compliment with compound interest whenever they get the opportunity, and thus not only are there more mistakes made than there should be, but each and every one of them is more expensive than it need be.

The matter is likely to be somewhat worse where the friction exists between the men in the shop and their foreman. There are a thousand ways in which men can "get the best of" a foreman whom they do not like, and on the other hand there are a thousand ways in which they can help along a foreman whom they do like, and the difference between these two conditions of things may represent thousands of dollars per year to a proprietor, and possibly the difference between commercial success and failure.

Friction between the superintendent and the foreman is equally disastrous to the success of the enterprise with which they are connected, and which they are employed and paid to advance. Whether it originates in jealousy, or in some other motive, friction of that kind which results in preventing a shop superintendent and his foreman from being entirely frank with each other, and from co-operating heartily for the success of whatever may be in hand, is fearfully expensive, and, where profits are not heavy, is ruinous.

The same may be said for friction existing between the drafting room and other departments, between the pattern shop and the foundry, or between the proprietor himself and any of the departments.

And it is to be remembered that such friction as we speak of—continued and chronic friction—there is absolutely no need for. It should not be regarded as one of the inevitable accompaniments of a manufacturing business, a necessary evil which must be put up with as best it may. There is always a way to remove such friction, and, if it cannot be removed in any other way, then heroic measures should be unhesitatingly resorted to.

The signs of such friction in the shop are as unmistakable as those of any other kind of friction, and are readily detected by him who is looking for them; they should be acted upon in much the same way that signs of friction in a machine are acted upon by the machinist. If there is undue friction in a machine, we know that there is something wrong, and that it will pay to remove that friction, if possible. If a better quality of oil, or oil more plentifully or more often applied will do it, then well enough, but if these will not suffice, then there must be some rearrangement of things, and so it must be with the friction between men connected with the shop; when it is discovered to exist, attention should be called to it, and it should be explained that such friction prevents the men concerned in it from doing their full duty to the establishment, and that for this reason, if not for the reason of its disagreeableness, it must be reduced to the normal amount. Lines must be drawn for all the parties concerned, each being given to understand distinctly just how far his authority extends, and what he will be held accountable for. Each must understand that he must not trespass upon the rights nor usurp the authority of another, and that harmonious working is especially desired. This may be said to be analagous to the cleaning of the bearings, smoothing them up, and making arrangements for their systematic lubrication. If this does not suffice, then there must be a rearrangement of the parts—in other words, a change of men. If there is constant friction between a machine shop foreman and the men working under his direction, it may be depended upon that either the men are to blame for it or the foreman is to blame for it—usually the latter. It should be the business of the superintendent or proprietor to investigate the cause of it, and to remove it at all hazards. The most expensive friction found in machine shops is not always in the machinery.

The report of the Rapid Transit Commission of this city having been made public and having met with a very favorable reception from engineers and the public generally, the next question is as to the possibility of making the roads as proposed pay dividends upon the investment of about one hundred millions of dollars, which it would probably cost to build them. The newspapers which are favorable to the road and hope to see it built are of course stoutly maintaining that those who take stock in the enterprise will, within a few years of its completion, be accumulating wealth very rapidly. The need of rapid transit for New York is so great and so apparent that it would seem that some road for supplying it ought to be made to pay, and if any road would pay, then the one proposed by the commission over the proposed route certainly ought to.

And taking a broad view of the matter, there can be, of course, no doubt that the values derived from such a road would pay handsomely for its construction. But the trouble with this, and all similar engineering enterprises, is that those who receive most benefit from them cannot be made to pay anything like their fair share of the expense involved.

It is perfectly safe to say that land speculators will make far more from this road than its stockholders ever can.

Profits of ordinary business or manufacturing operations will not be largely increased by the road, nor will wages, nor the values of machine shops nor their products. But the price of vacant lots and rents will be very much increased, and if such improvements as this, which must necessarily be a monopoly, could be carried out by the community, and their cost fairly collected from those receiving the resultant benefits, instead of being levied upon manufacturing and business interests, we should see far more great engineering work carried on. No doubt the stockholders of the elevated roads quiet their consciences, when pocketing their enormous dividends upon watered stock, by the thought that land owners in New York have made and are making from the road far more than its owners can ever hope to make; but where do the great body of working citizens come in, who are really doing the world's work in shops, offices and stores? They are simply permitted to use the road upon paying full value for the service. The world's work is not done by corner lot speculators, but by those who, by their individual efforts, create values of some kind, and the feeling is becoming general that their burdens should be lightened somewhat.

Alfred C. Hobbs.

Mr. Alfred C. Hobbs, of Bridgeport, Conn., died in that city on the 6th inst., at the age of 88 years. Few mechanics live to be better or more widely known than Mr. Hobbs, whose fame as an expert on locks became, in the early fifties, worldwide. At that time in London and other parts of England he opened easily, and in a surprisingly short time, locks, which it had been supposed were absolutely invulnerable, his exploits in this line astonishing the mechanical world, and leading to the complete revolution of the art of lock-making. He was led to this in a direct business way, he being connected with a lock-making firm in this city whose locks were usually put in to take the place of those of other makers so easily opened by him. In our issue of October 13, 1888, there will be found an extended account of his exploits in this line in connection with an account of some of the things seen at the works of the Union Metallic Cartridge Company, of which he was superintendent, and in which position he showed rare abilities and developed many highly ingenious machines and mechanical operations. He was a member of the American Society of Mechanical Engineers, of the Society of Arts of England, and associate of the Institute of Civil Engineers, by whom he was awarded the Telford medal—the highest honor awarded by that society, and the third medal brought to this country.

Literary Notes.

We have received a copy of the "Year Book of the Department of Engineering of the Brooklyn Institute for 1891-2." This is an institution which is doing a good work in the direction of stimulating and keeping up interest in engineering matters—the list of officers and members, with the program of past and future proceedings, showing that it is a live institution. Eight regular monthly meetings will be held during the 1891-2 season, on the second Tuesday evening of each month, at which lectures or papers will be delivered by Robert W. Hunt, M. E., president of the A. S. M. E.; Prof. J. E. Denton; Dr. Charles E. Emery, C. E; Dr. Rossiter W. Raymond; Oberlin Smith, M. E.; Louis Durinage, M. E., and Prof. Robert H. Thurston.

CONSTRUCTION AND USE OF MILLING MACHINES.—This is a new edition of the Brown & Sharpe Manufacturing Company's Treatise on Plain and Universal Milling Machines, in which there is a great deal that is entirely new matter, and though the illustrations and text relate specially to the machines made by that firm, the book yet constitutes the most complete and comprehensive treatise on the subject of milling in general that has ever been published, the results of experience as there recorded being valuable to him who, either as a novice or as an expert, has to do with the management or operation of any kind of milling machines, whether made by the publishers of this book or by other builders. The first part of the book is taken up with complete illustrated descriptions of the various machines made, and

the attachments for them, the balance of 93 pages being devoted to chapters on the care and use of milling machines; degree of skill required to successfully and economically operate them; cutters most advantageously used on them for all varieties of work; best methods of doing work, with illustrations; illustrations and complete list of all milling operations perf rmed upon some of the machines built in the works, accompanied by discussion of the best speeds, feeds, methods of handling the machines, etc; a chapter in which the subject of ordinary indexing is fully discussed, and another in which "Compound Indexing" is fully explained, and complete tables given by which any number can be indexed; this part of the work being credited to Mr. Walter Gribben and other writers in the AMERICAN MACHINIST. In the book, however, the tables and other information relating to the subject are carried out more extensively than was practical in our columns. The last chapter is devoted to the subject of cutting spirals, the matter being broadly treated, and with full and complete illustrations and tables. The experience of mechanics everywhere—both in this country and in England—has been liberally drawn upon for the matter contained in the book, and as this has been edited by a firm who have for years made a special study of milling machine constructions and of milling operations, it may reasonably be expected to be what it is, *i. e.*, a thorough, reliable and comprehensive book, invaluable to him who wishes to be thoroughly conversant with the subject of milling. We shall be doing a service to those who have or may receive the book by stating that in the heading of the third columns of the tables of compound index movements (pages 137 to 141) there is a typographical error, which, though made clear by the context, page 136, may possibly cause some confusion. The heading as it appears reads "Error on Diametral Pitch," whereas it should read, "Error on One Inch Diametral Pitch." Brown & Sharpe Mfg. Co., publishers, Providence, R. I. Price, cloth, $1.60; paper, 75 cents.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(496) A. H., ——, writes: Suppose I have a piece of work held in the chuck of an ordinary lathe, and find that in boring a 2″ hole 6″ deep, it is $\frac{1}{64}$″ larger at the back, with a gradual taper from end to end. Which way has the front bearing moved, forward or backward? *A.*—It has moved forward.

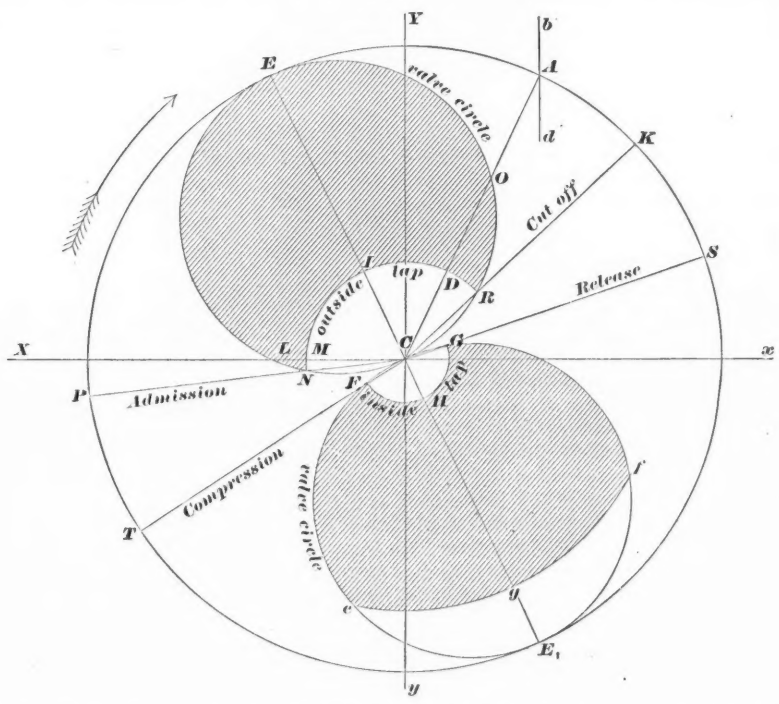
(497) L. R. B, ——, writes: I would like to know the simplest method for gearing a lathe simple and compound for cutting threads of any pitch. *A.*—You will find the simplest rules we know how to frame for this in our issue of March 12, answer to Question No. 121. This question is so often repeated, that, in justice to others who are waiting for answers, we cannot print it twice in the same volume.

(498) J. G., Waltham, Mass., writes: We have had a little dispute regarding the use of the terms bush or bushing, and would like to know which, in your opinion, is right. *A.*—We think that either may be considered to be right, although there should perhaps be a little preference for the term bushing, because it distinguishes the machinists' bushing from the ordinary bush which grows.

(499) L. B., St. Louis, writes: I would like to know the method of cutting fine threads on steel about 4″ long, 100 to the inch, as on Edison's phonograph. I have accomplished it by the use of a black diamond, but it is too expensive a process. *A.*—We should do it in a lathe in the same manner as any other thread is cut. Such a job is by no means beyond the skill of a good mechanic using ordinary appliances, if he has a good lathe which is adapted for fine work. Any machine shop in which good tool work is done can cut such threads for you, if you cannot make a success of it yourself.

(500) A. R. W., ——, asks: On seeing an article marked patented, how am I to find out what particular feature of that article the patent applies to? *A.*—Usually the manufacturer will inform you on this point, if you write him a courteous letter of inquiry, inclosing stamp for reply. Otherwise you can find out by an examination of the *Patent Office Gazette*. 2. Can an article be manufactured without liability when it is marked "patent applied for," yet the patent never taken out? *A.*—Generally speaking, yes. The words "patent applied for" on an article are no protection, except in so far as they give notice that a patent has been applied for, and that it will therefore presumably not be worth while for any one else to start into the manufacture. Of course, if a number of years elapse, and the patent is not taken out, the presumption may be that for some reason it will not be issued, in which case it is not protected. 3. Do the patent laws require that every article patented shall be marked patented? *A.*—Yes.

(501) F. W., Portland, Oregon, writes: Please answer the following questions: Is there any way of telling how far the ports of a common slide valve and a piston valve are open at any part of the stroke of the engine when the width of the ports, steam and exhaust, lap and travel of the valve are given, without taking off the steam chest cover? If so, please give rule. *A.*—Let the outside lap be 1 inch; inside lap, $\frac{1}{4}$ of an inch; width of port, $1\frac{1}{2}$ inch; travel of valve, 5 inches, and lead, $\frac{1}{16}$ of an inch. Draw the horizontal line $X x$ and a line $Y y$ perpendicular to it, intersecting each other in the



point C. From C as a center and with a radius equal to one-half of the travel equal $2\frac{1}{2}$ inches, describe a circle $E A E E_1$. Now lay off the angular advance $A C Y$ corresponding with the crank position $X C$, the crank moving in the direction as indicated by the arrow. This angular advance is laid off in the following manner: Draw a straight line $b d$ parallel to $Y y$; the distance between these lines must be equal to the sum of the lap and lead, hence in this example this distance will have to be $1\frac{1}{16}$ inch. The line $b d$ cuts the circle in the point A join A and C by a straight line, then $A C Y$ will be the angular advance of the eccentric, and the line $A C$ will be the position of the center line of eccentric. But for the purpose of investigating the motion of the valve we must transfer the angular advance to the other side of $C Y$, hence make $E Y$ equal $Y A$, and through E and C draw a straight line and prolong it to cut the circle $E A E_1$, in the point E_1. On the line $E C$ as a diameter describe the circle $E O N$, cutting the line $X x$ in the point L. On $C E_1$ as a diameter, describe a circle $C f e$; this circle and the circle $E O N$ are called the valve circles, and, as will be seen, the diameter of each is equal to one-half the travel of the valve. From C as a center, and with a radius equal to the outside lap, describe an arc cutting the circle $E O N$ in the points N and R, and cutting the line $X x$ in the point M. Again, from the center C, and a radius equal to the inside lap, describe the arc $F H G$, cutting the valve circle $C f e$ in the points F and G. Lastly, make $H g$ equal to the width of the steam port, and through g draw from the center C the arc $e g f$; this completes the construction of the diagram, which is called Zeuner's diagram. Now to find the port opening for any position of the crank we have simply to draw the center line of the crank through the center C, and then measure that portion of the center line which lies in the shaded part, or that portion intercepted between the lap circle and the valve circle. Thus: The line $X C$ represents the center line of crank at the beginning of the stroke, $L M$, the part of $C X$ intercepted by the shaded part, is the amount of port opening, and this is of course equal to the lead. When the crank is at $C E$ the port is opened to its full width $I E$; in a similar way, when the crank is at any other position, say at $C A$, the port opening is equal to $D O$. At $C K$—the line which passes through the point R—the port is closed and steam is cut off. When the crank is at $C S$—the line which passes through G—release commences; and when the crank is at $C E E_1$ the exhaust edge of the valve has traveled beyond the edge of the port a distance equal to $E_1 g$; hence during the time that the crank travels from f to e the port remains fully open to the exhaust. At $C T$—the line which passes through the point F—the exhaust is closed, and compression commences, and at $P C$—the line passing through the point N—admission commences. For the sake of clearness, the lap circles have not been drawn to the scale. In this diagram the angularity of the connecting rod has not been taken into account; if this be taken into account, the so-called valve circles will not be true circles. Of this we may say something in the near future. 2. What is the advantage of a beam engine, compound and triple expansion engine over one another? *A.*—The simple beam engine is often adopted where space will not permit the use of another type under given conditions. For instance, on a ferryboat where a long-stroke engine with one cylinder is demanded, working with a comparatively low steam pressure, say 40 pounds, the simple beam engine is well adapted. It is well known that a greater economy in fuel can be obtained with a higher steam pressure, and expanding the steam to a low terminal pressure. If the steam pressure is increased to say 120 pounds, and expanded down to 20 pounds, it is best to expand the steam in two cylinders, so as to reduce the cylinder condensation as much as possible; hence in this case a compound engine is preferable. If the initial steam pressure is say 150 pounds, it is generally best to adopt a triple-expansion engine, so as to reduce the range of temperature in each cylinder, and thereby avoid again as much as possible the cylinder condensation, which is greater in amount the greater the range of temperature, and is materially reduced by dividing the expansion into a number of stages.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Ready-made cut Iron list gears. See page 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

$13 00 I Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N Y.

To get the best work out of a Star Hack Saw, bear down heavily, and draw it very slowly.

S. A. Smith, 23 South Canal Street, Chicago, Ill., agent for Holbrook's Raw Hide Blanks for Gears.

Our Automatic Gear Cutting Machine will increase production 50% The Superior Mach. Wks., Clev'd, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the latest improved Eccentric Hook, Connecting Rods and Stub Ends, address T. C. Dill Machine Company, Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co, 138 Jackson St., Chicago, Ill.

Save small iron from foundry refuse. It pays. Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.

Thos. Pray, Jr., 193 *Times* Build'g, N. Y., attends to calls for Indicating and Testing Steam Plants. Water-works, Locomotives & S. S.'s. Write or call.

For Sale—One 22″x22″x5′ Putnam, and one 22″x 22″x4′ Powell Planer. Both in first-class order. Price very low. W. P. Davis, Rochester, N. Y.

N. Y. City Bolt & Nut Co., Limited, 33 and 35 Desbrosses St., N. Y. City, manufacturers of Machine Bolts of every description. Write for estimates.

Milliken & D'Amour, No. 151 Cedar Street, New York City, designers and builders of labor-saving and automatic machinery and tools to order.

"Roper's Hand-books for Eng'rs and Firemen." Descriptive Catalogue mailed free to any address. Edw. Meeks, Pub., 1012 Walnut St., Phila., Pa.

25″ / 32″ / 37″ / 42′ — "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, Newark, N. J.

Complete treatise on Screws and Screw-making, with clear and concise explanation of the methods; 95 illustrations. Price, $1.25 postpaid. E. & F. N. Spon, 12 Cortlandt Street, New York.

"Hawkins' Calculations for Engineers," 10 Parts, 25c. each, bound, $2 50; Catalogue free; Theo. Audel & Co., Pubs., 91 Liberty St., N. Y.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy" By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES

A roller-mill is to be established at Ranchtown, Pa.

A cotton mill will be established at Nalanville, Tex

A new steel works plant is to be built at Charleroi, Pa.

The starting of a foundry at Lilly, Pa., is being discussed.

The Carolina Cotton Company, Sumter, S. C., has been incorporated.

A movement is on foot to establish a new cotton-mill at Indian Trail, N. C.

B. A. Bright & Co. contemplate the erection of cotton-mill at Munroe, La.

The Lanesburg Brake Company's plant at St. Louis, Mo., is to be enlarged.

Koehler Brothers will erect a machine shop at their plant at Saginaw, Mich.

Bristol (Penn.) is to have a new steel plant, and work on it will commence soon.

A brick foundry, to employ 250 hands, will be established at South Amboy, N. J.

Josiah Holmes is erecting an iron foundry and machine shops at Cumberland, Md.

R. R. Mingus, Glasgow, Ky., intends to rebuild his machine shops, recently burned.

The Berlin Machine Works, at Beloit, Wis., will erect a new foundry at their works.

An iron-foundering plant is to be established at Oakesdale, Wash., at a cost of $10,000.

An addition, 48x100 feet, is being erected at the works of C. John Reily, Pittsburgh, Pa.

The Eclipse Clutch Works, at Beloit, Wis., will build a branch foundry, to be 85x90 feet.

Harrison Soule, of Rochester, N. H., is to make an addition to his brass and iron foundry.

It is reported that a new cotton-mill is to be started at Carthage, N. C., to cost $30,000.

The flouring-mill of McMannes & Arnold, at Findlay, Ohio, was recently destroyed by fire.

A plant for the manufacture of galvanized iron tanks will be erected soon at Brenham, Texas.

The Pendulum Engine Works, of Chicago, Ill., has been organized, with a capital stock of $150,000.

An addition, 60x80 feet, is being made to the plant of the Wheeling (W. Va.) Corrugating Company.

Atlanta parties are corresponding relative to the establishment of an ice factory in Carrollton, Ga.

One hundred thousand dollars has been subscribed toward starting a steel plant at Maysville, Ky.

The Grand Trunk R. R. has recentiy had surveys made for a new railroad bridge at Trenton Falls, Ont.

The Dayton (Tenn.) Ice, Bottling and Cold Storage Co. contemplates erecting an electric plant next year.

The Speedy Cycle Manufacturing Company, of Chicago, has been incorporated, to manufacture bicycles.

Plans and specifications are being prepared for the construction of a $22,000 water-works system at Hope, Ark.

Brightman & Collins, of Cleveland, O., will erect a machine shop, to be 58x103 feet, two stories, and built of brick.

The Eagle Rolling-mill Company, of New Ulm, Minn., capitalized at $300,000, has filed articles of incorporation.

It is reported that an iron foundry and machine shop are to be erected at Cumberland, Md., by Josiah Holmes.

A movement is on foot to change the old Hanover Cotton-mill property at Whippany, N. J., into a sand-paper shop.

The King's Mountain (N. C.) Manufacturing Company will next spring put 2,500 additional spindles in its cotton-mill.

An extensive steel casting foundry, to employ 150 men, will be established at Irondale, Ind. B. O. Haugh can inform.

Van Wagoner & Williams will erect two stone and brick buildings for the manufacture of hardware at Cleveland.

There is some talk of a wire factory being established at West Bergen, N. J., by a number of Brooklyn (N. Y.) capitalists.

A company for the manufacture of electrical appliances is being organized in St. Paul. The capital stock is to be $100,000.

A stock company is being organized at King's Mountain, N. C., to erect a cotton-mill. The required stock is $50,000.

The Baltimore City (Md) Passenger Railway Company will soon commence work on the erection of its power plant.

The Hoyt Metal Company, of St. Louis, Mo., have completed a new factory at Arlington, N. J., which they will shortly occupy.

The R. S. True Co., of Syracuse, N. Y., has been incorporated, with capital of $15,000, to manufacture bicycles, tricycles, etc.

The Carson French Machine Company, of Boston, are to build a factory at Charlestown, 22x115 feet, with wing for boiler house.

A party is in correspondence with E. B. Jones, relative to the establishment of a $20,000 cotton-seed oil-mill in Stephenville, Tex.

New machinery will, it is stated, be put in the Tuscaloosa (Ala.) Rope and Yarn-mill for the purpose of doubling its capacity.

Staley & Swanger have purchased the Barrett Ice Factory, at Huntsville, Tex. Will improve, increase capacity of, and operate same.

It is reported that Pike Bros., of Hogansville, have purchased and will operate the plow factory of W. S. Cox, at La Grange, Ga.

It is stated that the Roane Iron Company, of Chattanooga, Tenn., will erect another iron furnace at Rockwood in the near future.

The St. Louis Screw Company is preparing plans for a new factory. The property was purchased some time ago, and is 150x140 feet.

The charter of the Texas Iron Rolling-mill has been amended, changing the location of the mill from Fort Worth to Tyler, Texas.

The Greenfield Boiler Company's works, at Greenfield, Mass., have been sold to Utica (N. Y.) parties, to which place the plant will be moved.

L. S. Bonbrake proposes to establish a plant at Nebraska City, Neb., for the manufacture of steel roofing and other iron building materials.

Pittsburgh (Pa.) parties are investigating at Radford, Va., with a view of establishing works for the manufacture of wood working machinery.

Creswell's Iron Foundry, at Philadelphia, Pa., is to be removed to a new site, where a two-story brick structure, 190x70 feet, is being erected.

B. S. Bosworth & Co., manufacturers of nails' East Taunton, Mass., are intending to add new machinery, thus giving them increased facilities.

Harry Le Laurin, of San Antonio, Texas, is reported as having purchased, and as to operate the boiler works of Kirby & Roots, Pine Bluff, Ark.

The Maxton Manufacturing Company has, it is reported, changed the location of and enlarged its iron foundry and machine shop at Maxton, N. C.

The cutlery works at Ottumwa, Iowa, have increased their facilities for manufacturing. Where 100 hands were employed there are at present 500.

The organization at Charleston, W. Va., of a stock company, for the purpose of manufacturing the self-locking nut patented by A. W. Ward, is talked of.

The city council of Memphis, Tenn., has adopted a resolution providing for the construction of a $10,000 iron bridge over Gayoso bayou at Memphis.

The Brush estate, of Detroit, Mich., have prepared plans for a foundry and machine shop, to be of brick, 41x91 feet, three stories, and to cost $8,000.

A company is being organized in Lockport, Ill., for the manufacture of plain and barbed wire, which will give employment to a large force of men.

The MacKinnon Machine Company, of New York, has just completed a five-story building, at Lafayette, N. J. Part of the building will be leased.

John F. Pollock, James M. Loring and Charles A. Loring have incorporated the Acme Motor and Machine Company, of East St. Louis. The capital stock is $500,000.

An addition, 150x100 feet, designed for the manufacture of Bessemer steel castings, is being added to the plant of the Sharon Steel Casting Company, at Sharon, Pa.

A cotton-mill to accommodate about 12,000 spindles and employ 500 hands is to be established at Old Town, Me. The mill will increase its capacity as soon as advisable.

The Paragon Manufacturing Co. has been incorporated at New Haven, Conn., with a capital stock of $16,000. The company will manufacture hardware, tools and specialties.

The Whitney Electrical Company, of Boston, are contemplating the erection of a new factory at Penacook, N. H., and if the plant is prosperous over 100 hands will be employed.

The North Wayne (Me.) Tool Co. propose to enlarge their work by erecting a building for the manufacture of hay and corn knives, for which they have an increasing demand.

The town of West Knoxville, Tenn., will hold an election on December 19, to decide as to the issuance of bonds to build bridges and sewers. J. W. Yoe, mayor, can give further information.

The Long & Goodhue Manufacturing Company, of Burlington, Vt., are building new machine shops, and when completed they will equip them with the latest and most improved machinery.

The Damon Safe and Iron Works Company, which was recently partially burned out at Cambridgeport, Mass., is contemplating starting a branch factory in the West, instead of rebuilding.

The Holyoke machine works has decided to build an addition to its present works, on account of the increase in its business. The new building will be of brick, 50 by 150 feet, and will be two stories high.

The Thomas Car Coupler Company has been incorporated at Sulphur Springs, Texas, by J. D. Lundy, of Chicago; Rice Harris, of St. Louis; J. B. Thomas, and others. The capital stock is $100,000.

The Richmond & Danville Railroad Co. (office, Richmond, Va.,) will, it is reported, erect machine shops at Cedartown, Ga., the site of which will be donated by the Cedartown Land Improvement Co.

The Lewis Valve Gear Co., of East St. Louis, Ill., has been incorporated by W. J. Lewis, L. B. Fisk and E. S. Marshall for the manufacture of valves, pumps, etc. The capital stock is placed at $600,000.

The firm of Cranston & Co. has been dissolved, and the firm of Cranston & Jones has been formed to supersede it. The company does a business as general machinists at 57-61 Park street, New York.

Emmet Bros. & Griswold, 150 Broadway, New York, issue a catalogue of special devices for electric railways. We should think the catalogue would be of interest to all who have to do with such matters.

N. Mackey, O. P. Kreiger and F. L. Taylor have incorporated the National Automatic Fan Co., at San Antonio, Tex., with a capital stock of $10,000. Its purpose is to manufacture an adjustable automatic patent fan.

The boilers, cylinders and steam pipes of the ferryboat "Cincinnati," illustrations of which we gave last week, are covered with fossil meal supplied by the Fossil Meal Company, of No. 2 Cedar street, New York.

It is stated that a large company is now preparing plans for the erection of a complete tin plant at Pittsburgh, Pa. They will do all the work, from rolling the steel billets into black sheets to the final process of tinning.

The boiler works of Henry Warden, at Germantown Junction, Philadelphia, are at work on boiler contracts for the Third avenue and Broadway cable systems of New York City, aggregating 14,000 horse-power.

We are informed that the Bucyrus Steam Shovel Company, of Bucyrus, O., is about to remove its plant to Milwaukee, Wis. The additional facilities provided at that point will enable the company to extend its business.

The plant of the Jones Car Company, at West Troy, N. Y., is to be increased by a large addition. This will double the capacity of the works, which are now overtaxed. The new plant will be in readiness for use by spring.

F. Lee, J. Strootman and R. Hoffield, of Buffalo, N. Y., have purchased 600 acres of pebble phosphate land in Polk and Hillsboro Counties, Fla., and will organize a company to develop same and erect an extensive plant.

$100,000 has been subscribed by the Louisville & Nashville Railroad Co., to the stock of the Southern Steel Co., who are organizing to build a steel plant at Ensley City, Ala. The proposed capital is $800,000, of which $750,000 is now subscribed.

The Connell & Dengler Machine Company, of Rochester, N. Y., has been incorporated, to make machines and machine supplies, and to operate a foundry. Capital, $1,000; directors, John Connell, Valentine Dengle, Jacob S. Irwin, and others.

The Imperial Phosphate Company, Istachatta, Fla., previously organized to develop phosphate mines, has been incorporated, with a capital stock of $50,000. J. F. McClendon is president; A. L. Miller, vice-president, and B. R. Milam, secretary.

The Electric Light Company, of Greensburg, Pa., has secured land for its new plant, and work thereon will soon begin. The plant will consist of a brick building, 60x40 feet, and will be equipped with two 50-arc dynamos, and two 100-horse engines.

The Bertha Zinc Company, of Pulaski, Va., will erect ten furnaces for making blue powder in case some experiments now being made prove successful. An open hearth furnace is the chief point in the experiment, as it is unlike all other zinc furnaces.

Mr. S. J. Wright, P. O. Box 386, Winsted, Conn., writes us: The old foundry at Winsted, Conn., will be in operation the first of the year by S. J. Wright & Co. It will be run in connection with the Wooster & Wilcox machine shop, which is now under construction.

The Peckham Street Car Wheel and Axle Company, of Kingston, N. Y., has been reorganized as the Peckham Motor Truck and Wheel Company, and the business of the new firm has been greatly increased. They expect to still further increase their plant and output.

The rebuilding of the Alabama Rolling Mill Co.'s works, at Birmingham, Ala., is practically completed, and the puddling-mill started up on the 26th ult. Seven new puddling and two gas heating furnaces have been added, which will greatly increase the capacity of the plant.

There is water-works agitation in Fargo, N. D.; Waterbury, Conn.; Glen Cove, L. I.; Santa Barbara, Cal.; Bartow, Fla.; Oshkosh, Wis.; Plainview, Minn.; Boston, Mass.; Asbury Park, N. J.; Stockbridge, Mass.; Linton, Ind.; Fairbury, Ill.; Egg Harbor City, N. J.; Decherd, Tenn.

John S. May, Philip Engelskirger, E. E. Hughes and others have incorporated the Souder Railway Freight Car Co., at Newport, Ky., for the purpose of manufacturing all kinds of freight cars for railways, according to the patents of Jacob J. Souder, of Washington, D. C. The capital stock is $2,000,000.

The Pennsylvania Tube Works will be increased by the addition of a furnace and all necessary machinery for making 36-inch pipe. The largest size now made by the company is 20 inch, and the largest made in the district is 24-inch. The capacity of the plant will be increased by 90 to 100 tons daily.

H. W. Petrie makes the following announcement: I take pleasure in announcing the removal of my business from Brantford to Toronto, Can. This step became necessary owing to the fact of my business having attained such proportions as to require the best facilities for transportation, also buildings and appliances for handling heavy machinery, etc. My new salesrooms and offices being near the Union station, in fact adjoining the station premises, gives visitors by rail an easy means of access.

The Hurlbut-Rogers Machine Company, South Sudbury, Mass., have just completed and moved into their new shop, which is 30x96 feet, 1½ stories high. The floor of the shop is laid on a foundation of crushed stone and cement three feet deep, giving ample foundation for all machine tools. The windows—ample in number—are double-glazed for cold weather. The offices, drafting room, pattern shop and storage room are on the second floor. A 45-light dynamo has been put into provide for good light.

Joliet (Ill.) is to have a tin plate factory. South of Joliet, one and a quarter miles, just over the border line, lies the new town of Lewistown. It is so called because it is the site of the Lewis Steel Sheet and Tin-plate Company, which has a capital stock of $500,000, and, so say the promoters, will begin turning out tin-plate the first of next year at the rate of 1,500 boxes per day, and employ 220 people. J. D. Lewis, a practical Welsh tin-plate maker, is president. Some Pittsburgh people are interested in the concern as stockholders. The plans provide for eight mills, and one of these is ready. The Santa Fe and Chicago & Alton Railroads touch the property, and both roads have put in switch tracks.

Mr. A. M. Morse, until recently of the firm of English, Morse & Co., Kansas City, Mo., has removed to St. Louis, Mo., with offices in the Commercial Building, corner Sixth and Olive streets. The business in the future will be conducted under the style of A. M. Morse & Co., who will represent leading manufacturers of high grade steam engines, both Corliss and high speed type; also improved boilers, steam pumps and other specialties, which go to make up complete steam power plants. They will offer only the best class of machinery at manufacturers' prices, and will make a specialty of designing and furnishing complete steam power outfits for any service; also the improvement and extension of plants already established.

A Novel Electric Railway for the World's Fair Grounds.

October 7 next the World's Fair grounds at Chicago will be opened to visitors for the inspection of the progressing work, and for their accommodation there is being constructed an electric railway of a most ingenious and novel character, having a capacity to carry 30,000 passengers per hour, with the greatest comfort, convenience and safety. The railway department of the Chicago office of the Thomson-Houston Electric Company have closed a contract with the Columbian Movable Sidewalk Company, of Chicago, for the electrical and steam equipment of the movable sidewalk which is now being installed. The mechanical and electrical plans and details have been carefully worked out by Mr. G. K. Wheeler, of the company, and under his supervision the entire plant will be installed.

By the time named above there will have been nearly completed a large number of buildings, and there will be much to attract and interest visitors. The electric railway, however, will be one of the leading novelties and attractions. This railway will differ from ordinary railways, in that the passengers are transported on a movable sidewalk instead of box cars of the ordinary type. The scheme is the invention of the Columbian Movable Sidewalk Company, of Chicago, and is being constructed under their patents.

This sidewalk is located on the improved and unimproved portions of Jackson Park, and is to be constructed on an elevated structure 25 feet high and 900 feet long, in the form of an ellipse, and is to consist of 75 cars, each 12 feet long, connected together, making one solid train. There are to be constructed two parallel sidewalks, one running at the rate of two miles an hour, the other at four, both walks moving in the same direction. The passengers can step from the stationary walk to the one which moves at the rate of two miles an hour, and if it is desired to move at a greater speed they can step from this walk to the one running at four miles per hour. The passengers can safely walk upon either of the movable sidewalks while in motion if desired.

The structure will be illuminated at night by a number of Thomson-Houston incandescent lights, and as the grounds are to be illuminated with arc lights, a satisfactory view thereof can be obtained during the evening as well as during the day.

Three of the 75 cars are to be equipped with two 15 horse-power Thomson Houston railway motors each, mounted upon trucks with wheels 18 inches in diameter. As the car platform or sidewalk is arranged it is perfectly level with the stationary walk, allowing the trolley wire to be placed beneath the surface of the platform, and the current taken therefrom by means of small trolleys attached beneath the car floors.

The operation of this train of cars will be arranged in a novel manner, doing away with the use of motor men, the entire train being controlled and operated by one man. There will be constructed at a central point at one side of the track a controlling station, which will contain a main switch, reversing switch, automatic circuit breaker, lightning arrester, ampere meter and rheostats, all arranged so that they can be operated by the attendant from that point, who will have the train under perfect control. As an additional safeguard, push-buttons will be arranged at twelve equidistant points along the line of track, which will be connected with an electric bell and the circuit breaker in the controlling station, and in case of accident to any of the mechanism of the train, an attendant can, by pressing the button, automatically open the circuit at the station and stop the train instantly, without the assistance of the operator.

The power for the operation of the sidewalk will be furnished by a Thomson-Houston 110 horse-power multipolar compound wound railway generator, located in a power house adjacent to the track. In connection with the generator there will be placed a

suitable switchboard, regulating, controlling and indicating devices of Thomson-Houston Company's manufacture.—*Electrical Review.*

Universal Bench Vise.

The accompanying illustrations show the construction and various positions in which it is possible to place a new bench vise which has recently been brought out by J. F. Emmert & Son, Waynesboro, Pa. The vise is intended mainly for the use of pattern makers and other wood workers, Fig. 1 showing it in the ordinary position, in which the outer jaw can be made parallel with the fixed jaw, or at an angle with it for tapered work; Fig. 2 showing it with the jaws placed upright; Fig. 3 in still another position; and Fig. 4 gives a sectional view which we have prepared in order to make the construction understood.

The fixed jaw, *i. e.*, the one next the bench, is hinged to a casting which is fixed to the bench, this casting being designated bp the letter *D* in the section, Fig. 4, the pin of the hinge being shown by the dotted circle near the top of *D*. By this hinge the entire vise is placed in any position, moving in a vertical plane, and can be secured in any position by the screw *N*, which binds the slotted link seen. The piece *D* is really a turn table upon which the inner jaw can be revolved upon an axis which passes through the center of the screw, and can be secured in any position by means of the lock lever *H* and screw *J*. These two motions combined make the vise really universal in the sense that it can be placed in any desired position, as may be most convenient for the workman, *i. e.*, in line with either the top or side of the bench, or at any angle with either. At one side of the main jaws there is a pair of jaws that are formed the same as those on a machinist's vise, so that metal pieces can be held in these when desired, as is often the case in pattern making especially. Sliding stops are placed in the jaws, as shown, which may be used for holding work, and, in fact, the object has been to provide a vise in which any possible piece of work can be readily and securely held in any possible position. The advantages of such a vise will be readily appreciated by experienced wood workers.

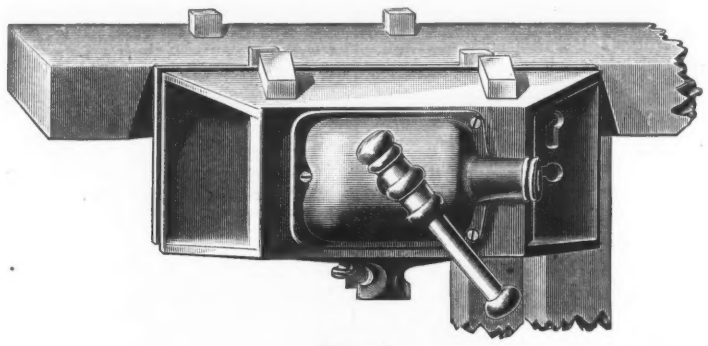


Fig. 1.

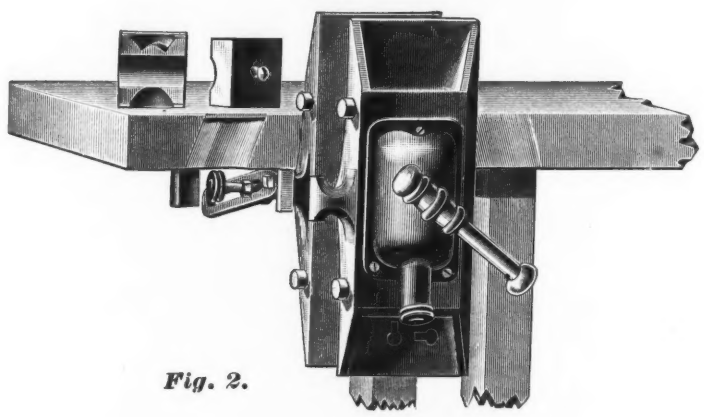


Fig. 2.

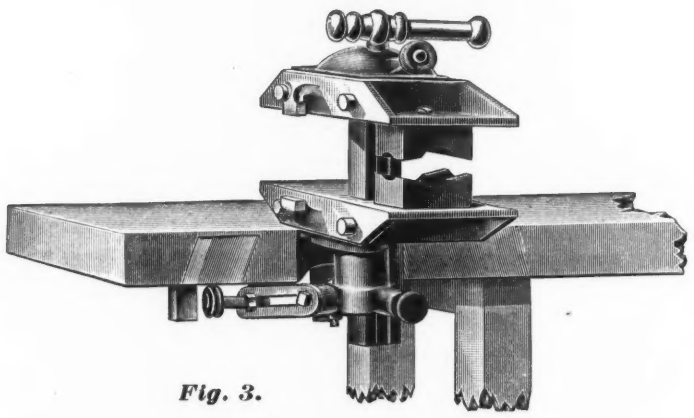


Fig. 3.

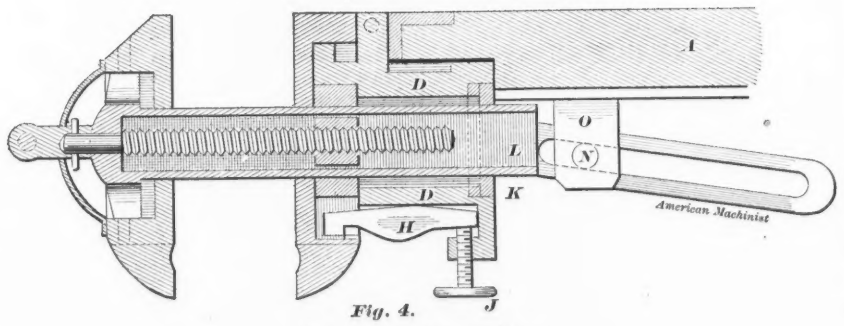


Fig. 4.

UNIVERSAL BENCH VISE.

New Pipe Tongs.

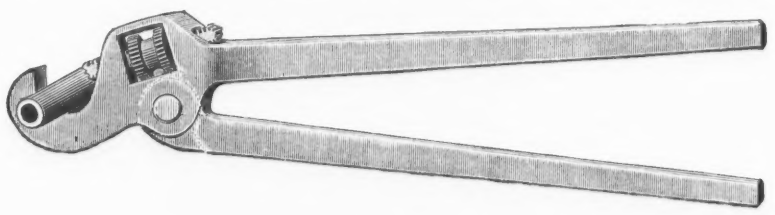
The accompanying illustrations show a new pipe wrench which in construction differs materially from the usual form. The handle on which the hooked jaw is formed is called the main handle, and is provided with an enlargement near the hinge, in which is placed a milled nut which is movable within certain limits, as shown. Through this nut passes the sliding jaw which has teeth at either end, so that it can be reversed and used either way. In the middle of the nut is an annular groove which is engaged by a lug or projection on the other handle, by which, when this handle is drawn in toward the main handle, the nut and sliding jaw are forced forward toward the pipe. This construction results in two things that are of some importance. First, grip on the pipe can be made sufficiently tight before attempting to turn, to effectually prevent any danger of tearing the pipe, and, second, the crushing of pipe can be prevented by so adjusting the nut that, when sufficient gripping force is applied to the pipe, the nut will come solidly against the forward side of the recess in which it is placed, and no further pressure can then be brought upon it.

In use the wrench is, of course, handled in the ordinary way. It is made of good steel carefully tempered, the intention being to provide a first-class tool. The manufacturer is Mr. Frank S. Patton, Twenty-ninth and Holly streets, Kansas City, Mo.

A recent explosion of natural gas in Pittsburgh, Pa., caused the death of one person, and serious injury to four others. Gas had been escaping in the cellar of a building, and in searching for the leak, with a light, the explosion occurred.

American Workshops.

At a meeting of the Manchester Association of Engineers, held on Saturday last, under the presidency of Mr. Samuel Dixon, Mr. Hans Renold read a paper on "Some Leading American Workshops." Mr. Renold gave his impressions of a few of the best American workshops which he visited in the early part of the year, and described in detail the shops of Messrs. Brown & Sharpe, Providence, R. I. Mr. Renold, who is evidently an enthusiastic admirer of the American mechanic, laid particular stress upon the manner in which this individual was treated. He was, however, careful to enforce upon his audience that his opinions, when derogatory to English workmanship compared with that across the Atlantic, were based on an inspection of the best shops; but even with this proviso he was greatly struck with the skill, the touch, and the understanding of the American workmen. A reason for this he found in the specialization of the machine trade in America. In the States, firms were found making one thing, and one alone, to an extent of which it was hard to conceive. By this means they were enabled to give their exclusive attention to the perfecting of special tools and appliances, by which the cost of production was reduced in a most remarkable degree. At a shop he visited in Boston, for example, he saw patent milling cutters being made at the rate of 64 per hour by a dozen men, £1 spent in wages producing £30 to £40 worth of goods. In the course of his remarks Mr. Renold paid a well deserved compliment to our esteemed contemporary, the AMERICAN MACHINIST, alluding to the practical character of its contents. As it was evident that Mr. Renold had still much to say at the close of the evening, and as it was intimated that his views were not to be allowed to pass altogether unchallenged by his audience, the meeting was adjourned until Saturday next, the 31st inst.—*The Mechanical World of Oct.* 30.



NEW PIPE TONGS.

The British iron trade report on the production of pig-iron and steel during the first six months of the present year shows the output of pig-iron during the half year to have been 3,812,787 tons, against 4,168,464 tons in the corresponding half year of 1890. The decrease was consequently 355,677 tons, or 8½ per cent. Compared with the output of the six months ended December 31, 1890, which was 3,706,660 tons, there was an increase of 106,121 tons, or nearly 3 per cent. Until the statistics with regard to the production of manufactured iron are issued, it is impossible to draw a correct comparison; but the figures relating to the output of steel are furnished in the same report, and from these we perceive a corresponding decline. The production of Bessemer steel ingots in the first half year of 1891 amounted to 923,005 tons, against 1,055,280 tons in the corresponding half of 1890. This shows a decrease of 132,275 tons, or 12½ per cent. The output of open-hearth steel ingots during the past half year was 778,888 tons, compared with 753,572 tons in the corresponding period of 1890, which is an increase of 25,316 tons, or 3.3 per cent. The production of steel ingots of all kinds in the first six months of 1891 was consequently 1,701,893 tons, against 1,808,852 tons in the corresponding six months of 1890. This shows a total decline for this year of 106,959 tons.—*The Engineer and Iron Trades Advertiser* (Glasgow).

An exchange says:

"Around a table in the café of the Chicago Club are to be found every day at lunch, Marshall Field, with a fortune of $40,000,000; George M. Pullman, $25,000,000; P. D. Armour, $20,000,000; L. Z. Leiter, $20,000,000; Potter Palmer, $10,000,000, and N. K. Fairbanks, $5,000,000. Field, Leiter and Palmer began life as clerks in dry goods stores, and Pullman as a railroad conductor. Armour and Fairbanks did not start at the bottom of the ladder.

The Moscow *Gazette* says that huge quantities of grain are exposed at every station on the railway from Vladikankas to Rostrov, and 4,000 freight cars are blocked.

Machinists' Supplies and Iron.

NEW YORK, November 14, 1891.

Iron—American Pig—The volume of trade is light, though there is evidence of strength in the market, so far as its general condition is concerned.

We quote Standard Northern brands, No. 1 Foundry, at $16 to $17; No. 2 is selling at $15 to $16.50, and Grey Forge at $13.75 to $14.50. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote Coltness at $23, and Eglington at $20.50.

Antimony—The demand continues good, and the market is higher.

We quote Hallett's, 13c.; Cookson's, 15¾c. to 16c.; L X, 13c.

Copper—Prices have still further declined for Lake, as a result of continued production above immediate demands. Not much is being done, but supplies can be had at 11⅜c. spot. Casting Copper is easy at 11c. to11½c.; Arizona Ingot, 12c. to 12¼c.

Lead—The market here continues dull, and quotations are nominal at 4.07c. to 4.15c.

Lard Oil—The market is steady, and prices are 53c. to 54c. for Prime City; Western is quoted at 52c.

Tin—Not much has been done during the week, but prices are lower, Spot being quoted at 19.70c

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Pattern maker exp'd in general pattern making, special mach'y, etc., desires sit. BOX 99, AM. MACH.

Foreman of machine shop desires change of position. A1 references. Change, AMERICAN MACHINIST.

Mech. draftsman wants a situation; New York or vicinity preferred. A. O., care AM. MACHINIST.

Mechanical draftsman, designer, wants sit. to work on pumping machinery. BOX 4, AM. MACH.

Pattern maker wants situation. Well up in general engine and machine work. BOX 5, AM. MACH.

A designer and draftsman, with technical education and shop experience, and has handled men, wants a position. Ohio, AMERICAN MACHINIST.

A young Scandinavian, college graduate, with two years' exp. in machine shop, wants position as draftsman. Address Box 4, Watertown, Mass.

Wanted—Situation as superintendent or foreman of boiler shop by a practical boiler maker; 1st-class references. Boiler Maker, AMERICAN MACHINIST.

Wanted—Mechanical draftsman; one familiar with cylinder printing presses pref'd. State age, exp., and wages wanted. C., AMERICAN MACHINIST.

Wanted—Quick and accurate tracer for drafting-room of Mch. Co. in large town near Cleveland, O.; permanent place to right party. Gregor, AM. MACHINIST.

A first-class mechanical draftsman desires position; thorough in engine and general machine designing, competent to take charge, excellent references. Address Box 100, AMERICAN MACHINIST.

Wanted—Salesman to sell machine tools—must be well posted—for New York city and vicinity; a hustler and good man; good salary and permanent engagement guaranteed; all communications strictly confidential. Hustler, care AM. MACHINIST.

Wanted—A first class draftsman, tech. educated and exp'd in designing simple, tandem and cross-compound Corliss eng., for power plants & mining mach'y; energy & ability will be appreciated; give ref. and outline of exp. Box 96, care AM. MACHINIST.

Wanted—A thorough machinist, capable of instructing classes in school shop. Must understand thoroughly the principles of tool operations, and be able to express himself clearly. Good salary for the right man. A young man preferred. Address "Brooklyn," care of AMERICAN MACHINIST.

Position desired as superintendent, by a thoroughbred, driving man, accustomed to take entire charge of shop. Well up in modern machine and foundry work, with long experience in getting up whole plant for making high-class, interchangeable work. Address BOX 3, AMERICAN MACHINIST.

A young man, 24, seven years' experience in some of the best pattern shops of the East, and at present drafting, wishes a chance as assistant draftsman where ability and attention to business will secure advancement. A permanent position the object. Machine tool or engine work preferred. Address Box 2, AMERICAN MACHINIST.

Wanted—An experienced mechanical superintendent familiar with modern methods, and who can command some trade, to take the management of shops and a small money interest in an established machine works. The plant is located on a 27-acre tract between two trunk lines, with a siding up to doors from one, and has both water and steam power. Coal and iron are delivered at works at Philadelphia; prices and freight rates on products to all points are very low. A rare opportunity to right man. Address, for five days, W. D., P. O. Box 2172, N. Y.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Corliss engs. and gen. mach'y designed, working drawings made. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Wanted—A modern Corliss engine, about 175 H. P. Must be in good order. Chicago Forge & Bolt Co., 40th Street and Stewart Ave., Chicago.

Special leather and cement for covering pulleys; no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

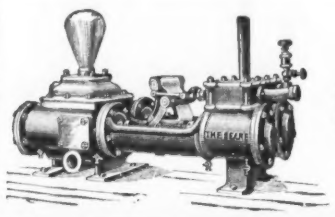
To manufacture light special and automatic machinery, novelties, models, patterns, tools, etc., by Orange Machine and Repair Works, Orange, N. J.

Wanted—A1 machinist or pattern maker, to take an interest in my machine shop, to manufacture small engines. 2615 & 2617 Strand, Galveston, Texas.

Wanted—Gear Planer—Gleason preferred; second-hand or new. Also a Corliss Engine, 12"x30" or 10" x36" for cash, 36" to 42" planers 12' or longer. Address Box 1, care of AMERICAN MACHINIST.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Wanted—A foundryman, way up on fine work, with some capital to put in a foundry in connection with a factory in the South—an unusual opportunity. Address Winslow, 1542 North Wolf Street, Baltimore, Md.



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STEAM PUMPS
DEANE STEAM PUMP CO.,
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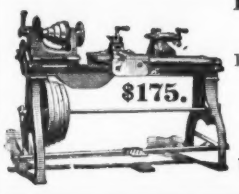
FOR TOOLS. CRESCENT STEEL FOR DIES.



Improved Screw Cutting Foot and Power. LATHES
Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
THE SEBASTIAN-MAY CO.,
167 to 175 Highland Avenue, SIDNEY, OHIO.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

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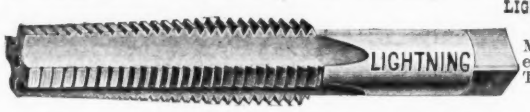
LIGHTNING AND GREEN RIVER SCREW PLATES.



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Men test everything in this world by what it produces.
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OF CLEVELAND, OHIO,
MANUFACTURE THE MOST SUCCESSFUL
POWER HAMMER
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BEFORE BEING PUT ON THE MARKET.
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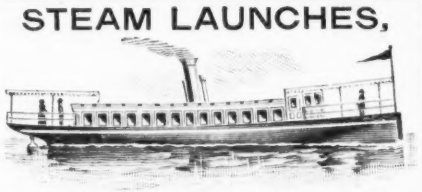
Author of STEAM ENGINE DESIGN.
908 Pages. 795 Illustrations. 22 Folding Plates. 8vo., Cloth, $10.
JOHN WILEY & SONS, NEW YORK.

STEAM LAUNCHES,



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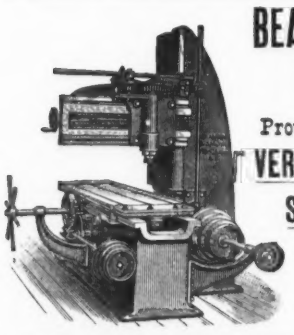
HIGH SPEED MARINE ENGINES All types of boat boilers, including the ROBERTS WATER TUBE SAFETY BOILER with our improvements. CHAS. P. WILLARD & CO., Catalogue free. 5 Dominick St., Chicago.

R. MUSHET'S SPECIAL and TITANIC STEELS.
How to get the best results with "R. MUSHET'S SPECIAL STEEL." Greatly increase your speeds and feeds; then compare the work you turn off with that done by any other known Steel. This will make the first cost of "Mushet's" look insignificant.
B. M. JONES & CO.,
Sole Representatives in the United States.
11 & 13 Oliver St., BOSTON, MASS.
143 Liberty St., NEW YORK.



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We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
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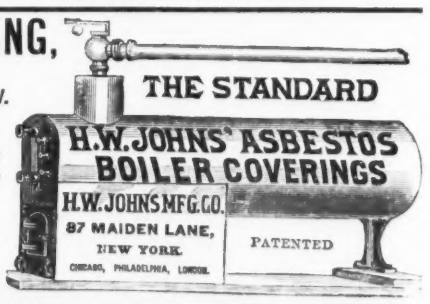

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We are now prepared to receive orders for this novel and valuable invention.
It can be seen in operation at our works, showing, in a test comparison with an ordinary lubricated bearing, a **remarkable saving of power.**
It is **applicable to frictional bearings generally;** such as **mill** and **shop shafting, car and other axles, propeller and side-wheel shafts, dynamos, electro-motors,** *et cetera.*
Further information upon application to the
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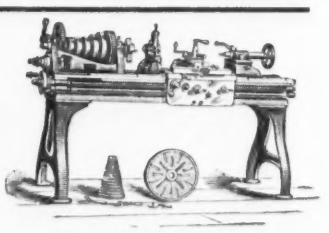
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Best polish and quickest cleaner known for HOT or COLD Brass, Copper, Nickel, &c., or finished Iron and Steel. *Samples Free.* Try it.
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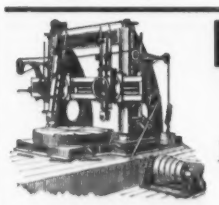
36th & BUTLER STREET, PITTSBURGH, PA.

BRISTOL'S Patent STEEL BELT LACING.

SAVES TIME, SAVES BELTS, SAVES MONEY, SAVES PATIENCE.
THE BRISTOLS' MFG. CO., Waterbury, Conn.

AMERICAN INSTITUTE FAIR, Third Avenue, 63d to 64th Streets.
DAIMLER MOTOR CO.,
Manufacturers of GAS ENGINES
ADAPTED TO
STATIONARY, LOCOMOTIVE AND BOAT PURPOSES.

DAIMLER MOTOR LAUNCHES
18 to 35 feet, 1 to 10 Horse Power.
Safest, Most Speedy, Cleanest, Most Reliable and Convenient Boats. No Steam. No Coal. No Ashes.
Office, 111 E. 14th Street, New York.
Next door to Steinway Hall.
Now on Exhibition at AMERICAN INSTITUTE FAIR.



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COMBINING EVERY IMPROVEMENT.
14 Sizes—From 5 to 20 feet.
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FOR EVERY VARIETY OF WORK.

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CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
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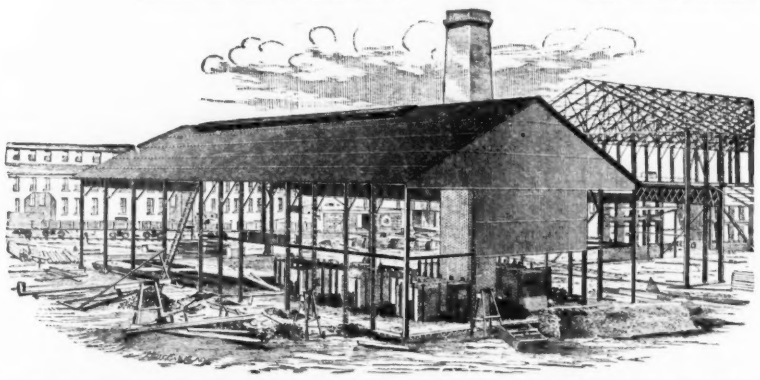

The above cut is taken direct from a photograph of an iron-bending shed built by us for The Chesapeake Dry Dock & Construction Co, at Newport News, Va. The photograph was taken during the progress of the work and before the final completion. Between the iron posts an 8" brick wall will be carried up to the eaves in order to protect the furnace from the weather. The building is entirely of iron, not a particle of woodwork being found anywhere in its construction. The iron frame of the building shown on the other side is the Ship shed which we built for the same Company.

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The advertiser, desiring to give his personal attention to other business, wishes to dispose of his Machine Tool Manufacturing Business, which is well established and located in an important center for that business. Stock, Machinery and Business are worth $30,000, with contracts and agencies insuring a prosperous business Address, MACHINE TOOLS, care of AMERICAN MACHINIST.

MACHINISTS' SCALES,
PATENT END GRADUATION.
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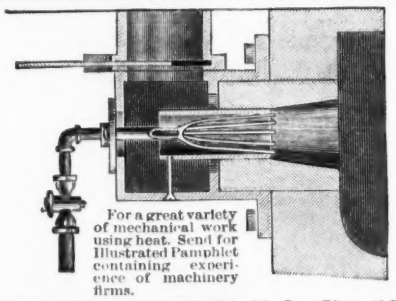
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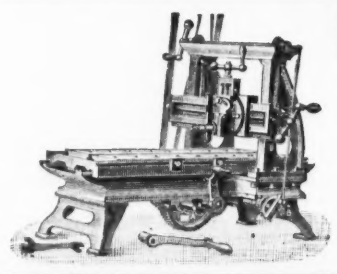

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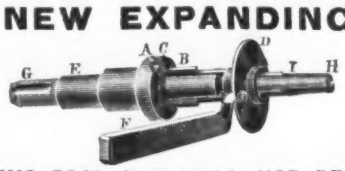

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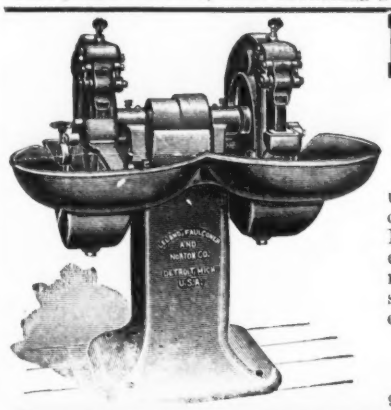

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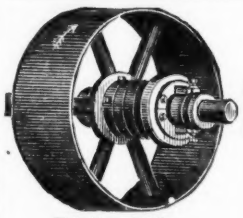
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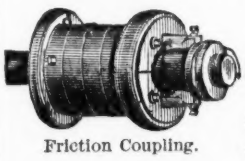
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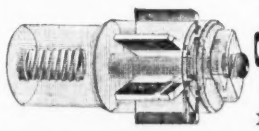

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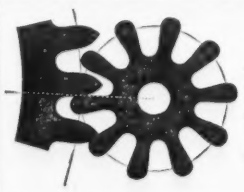

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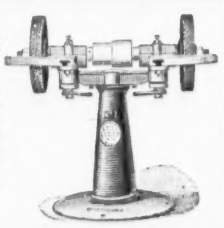

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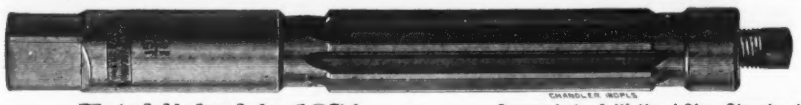

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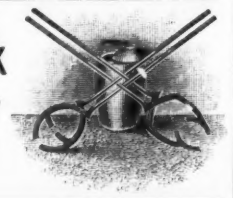

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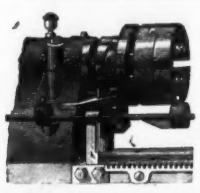

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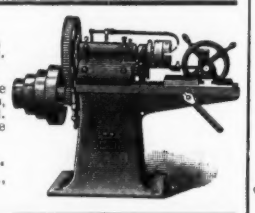

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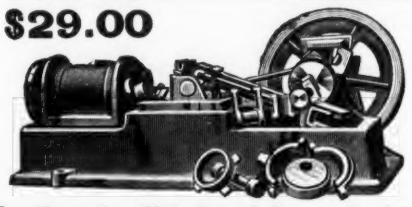

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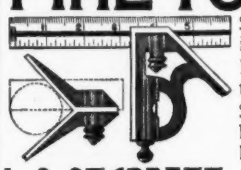

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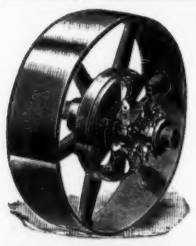

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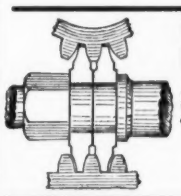

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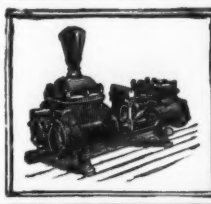

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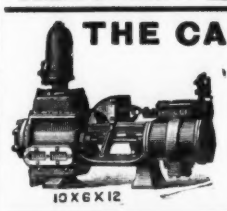

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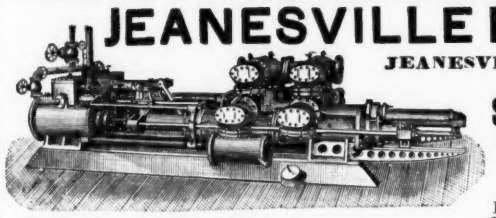

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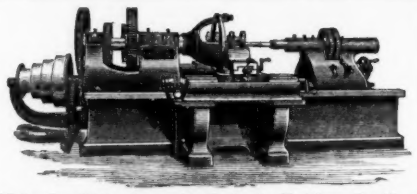

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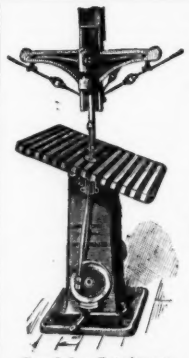

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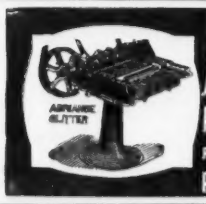

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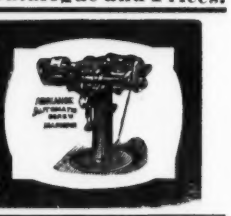

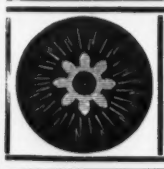

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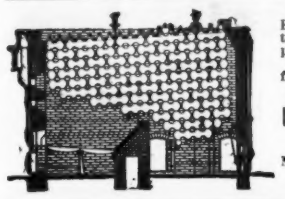

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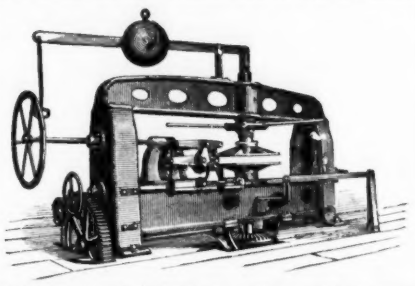

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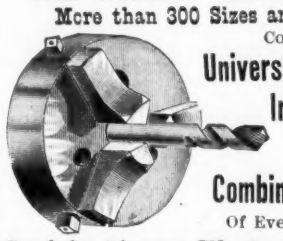

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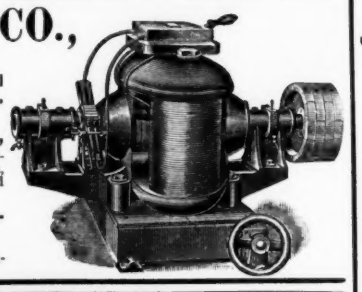

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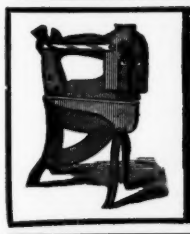

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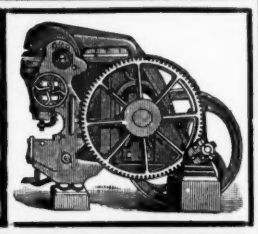

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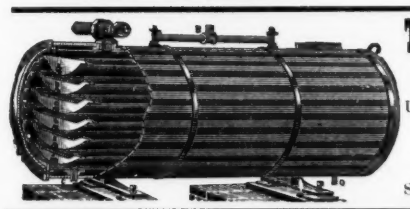

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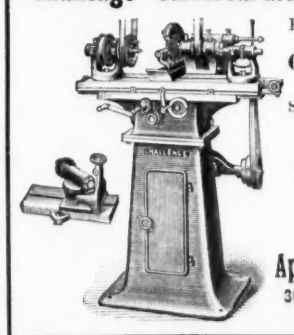

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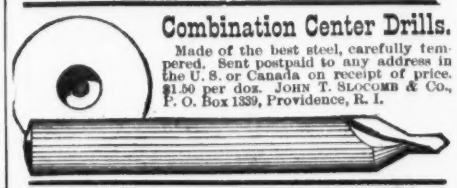

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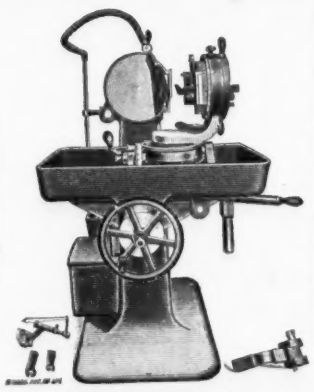

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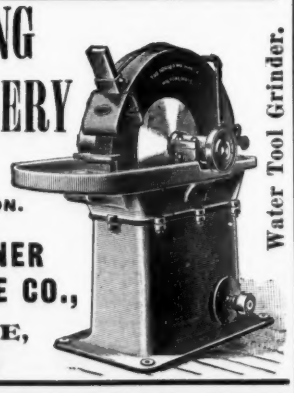

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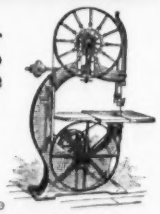

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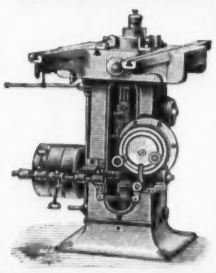

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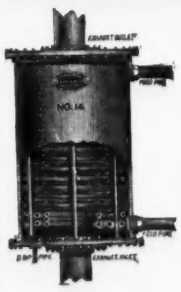

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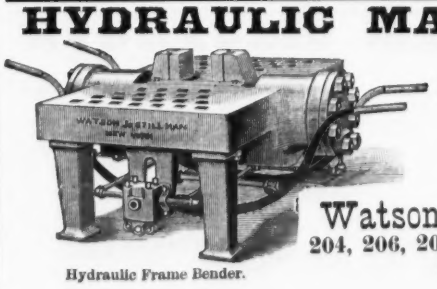

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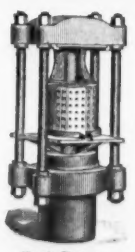

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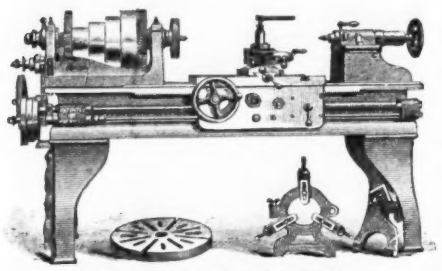

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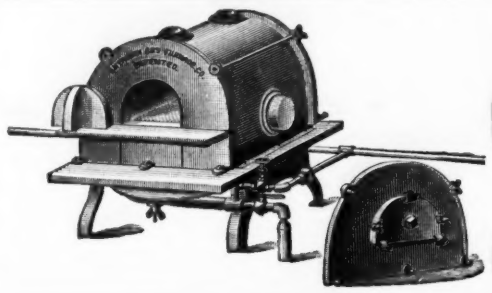

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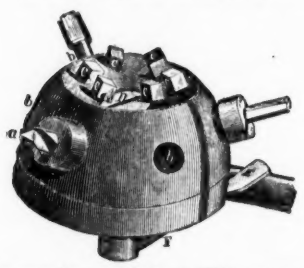

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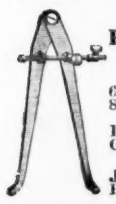

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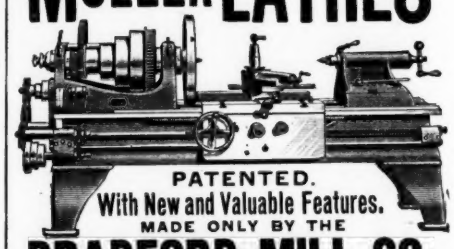

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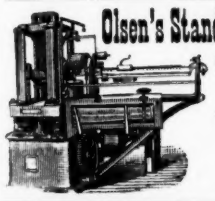

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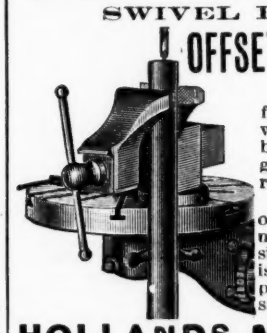

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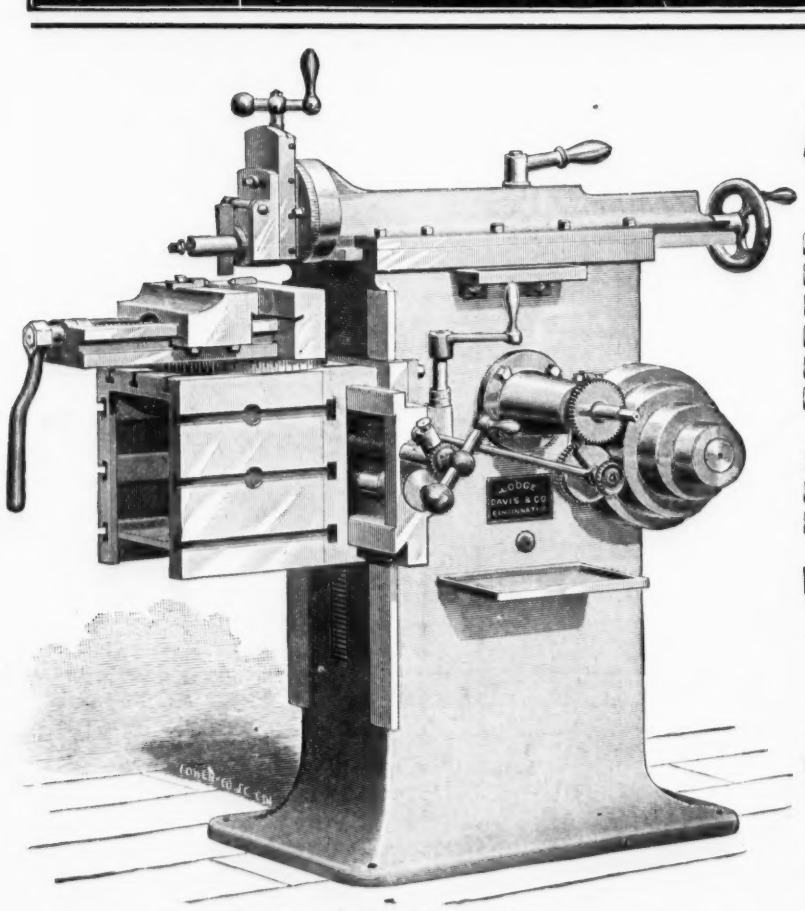

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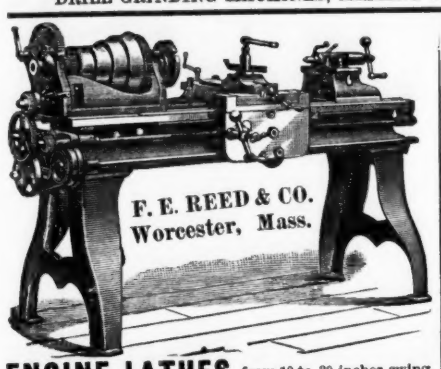

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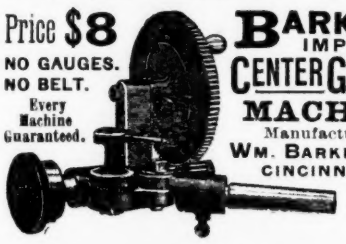

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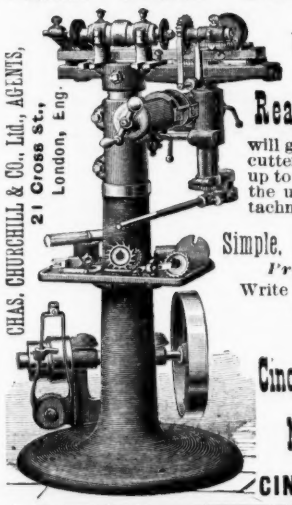

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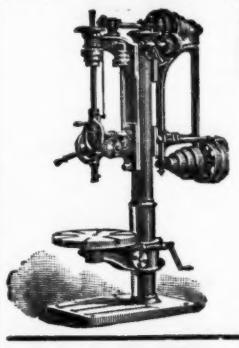

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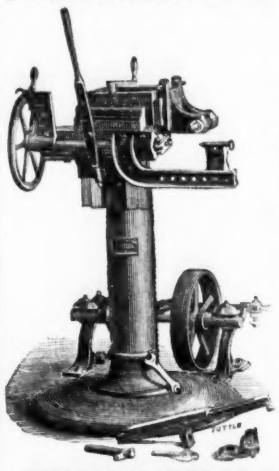

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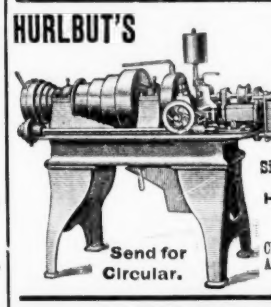

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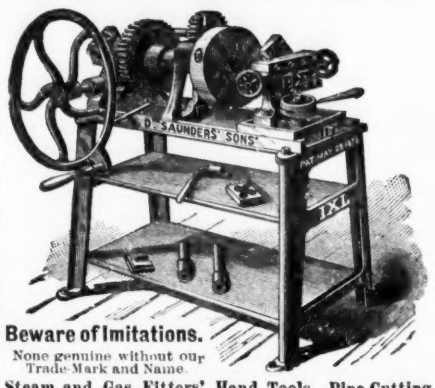

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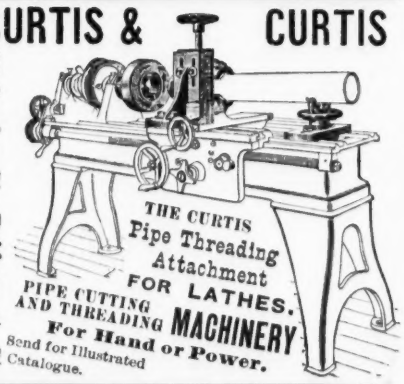

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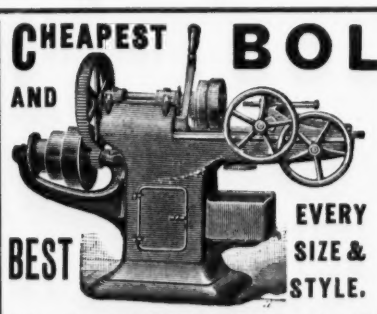

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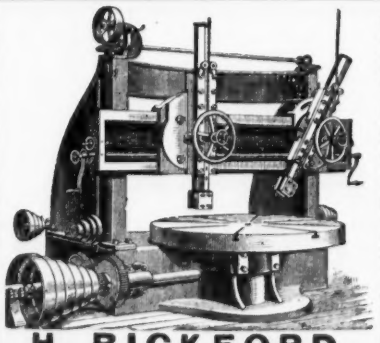

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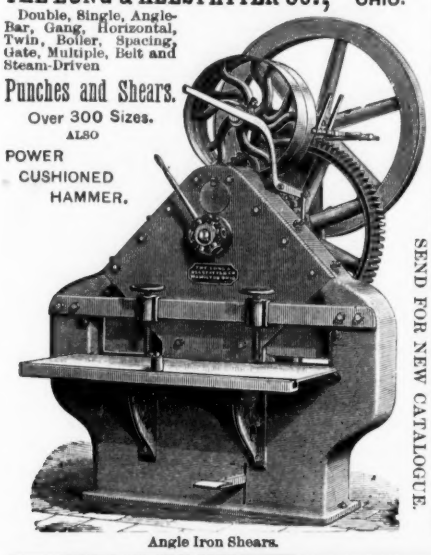
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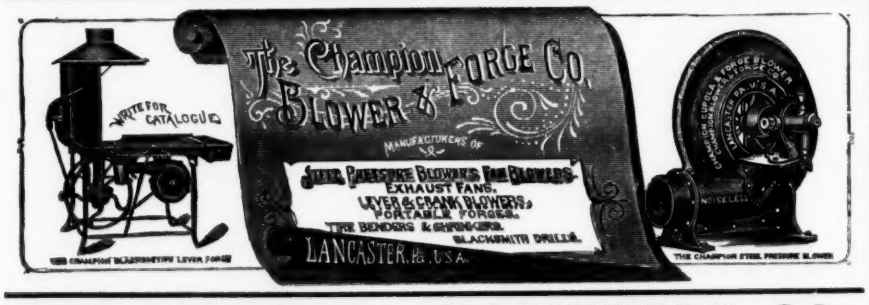

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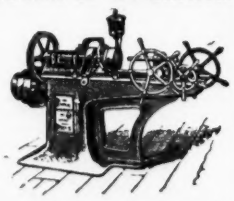

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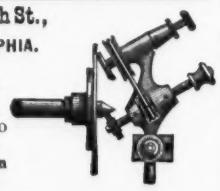

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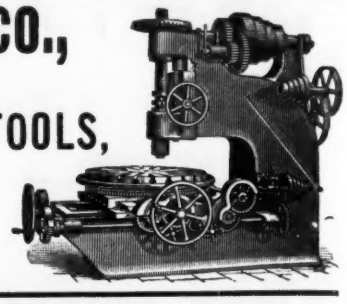

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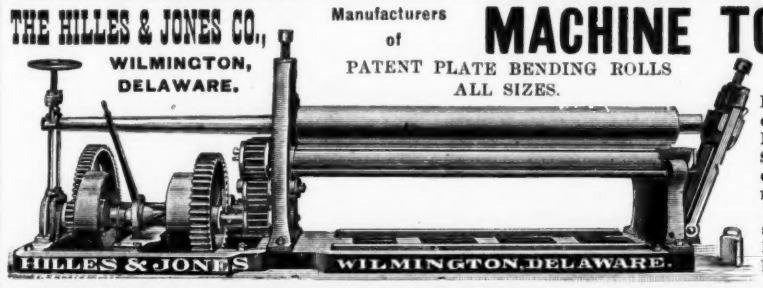

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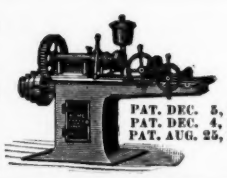
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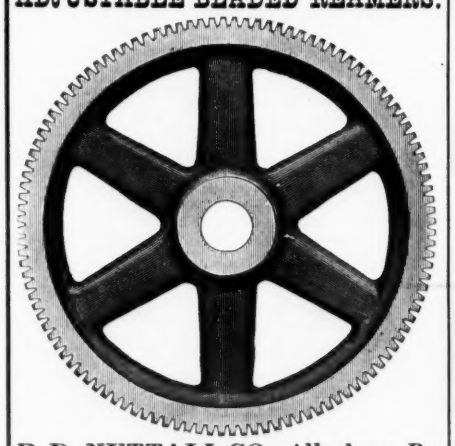
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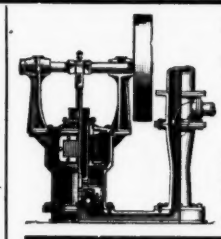
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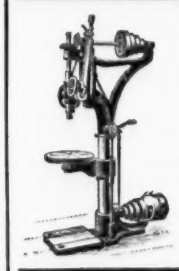
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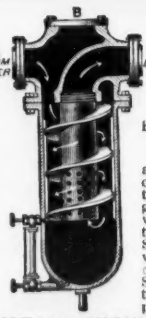

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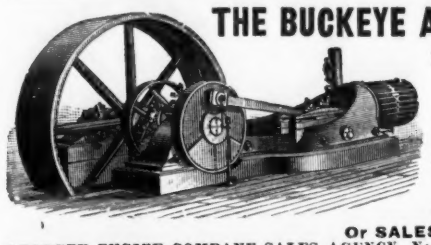

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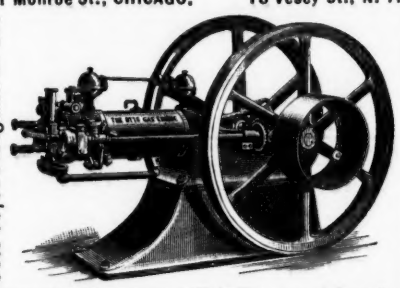

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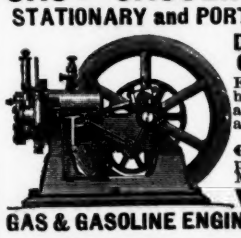

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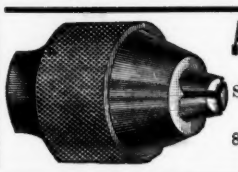

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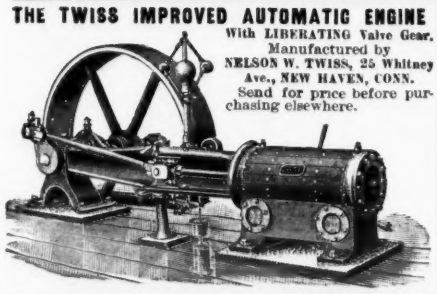

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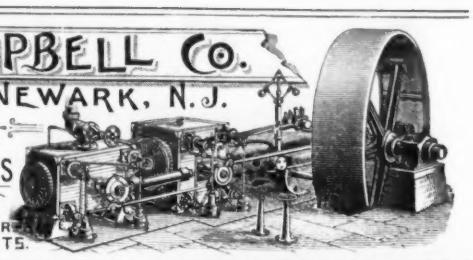

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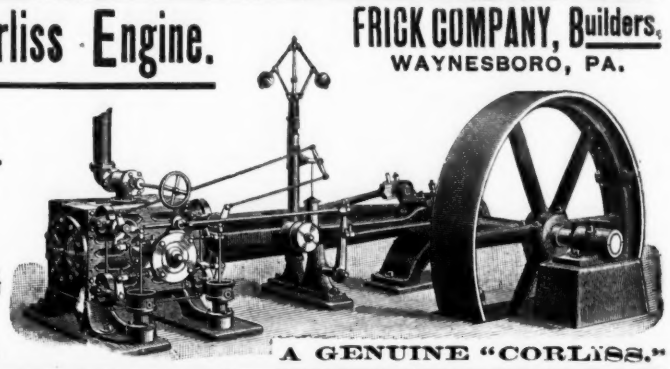

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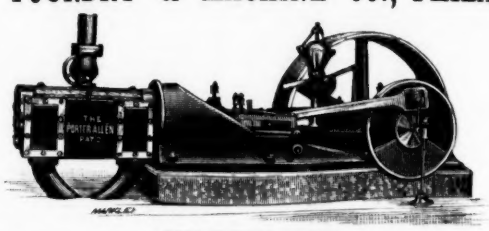

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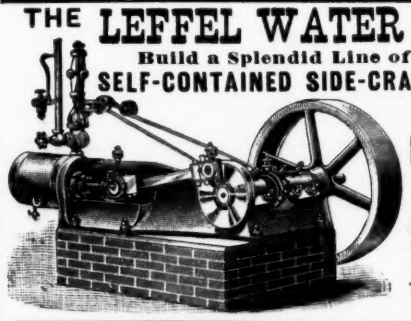

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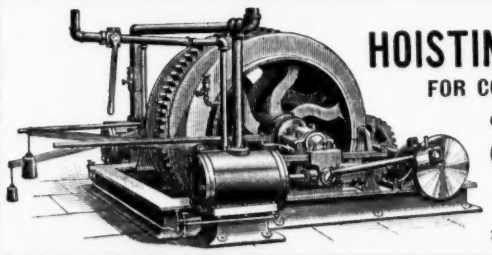

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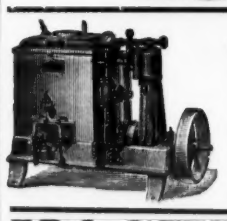

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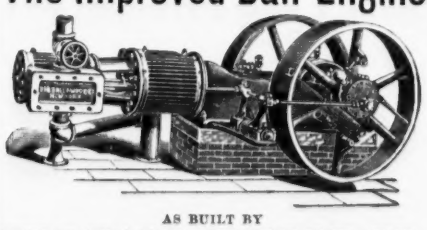

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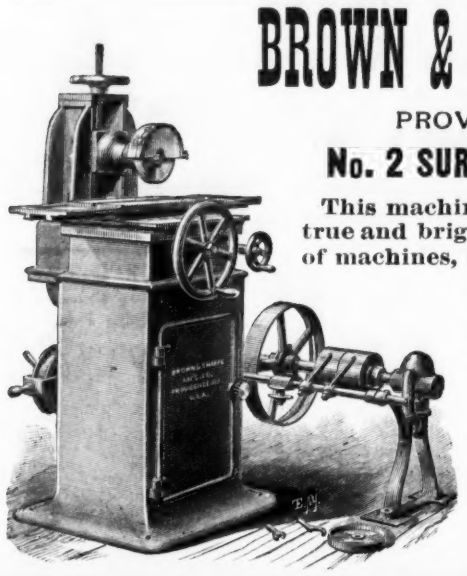

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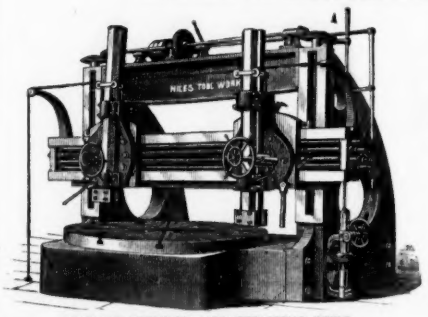

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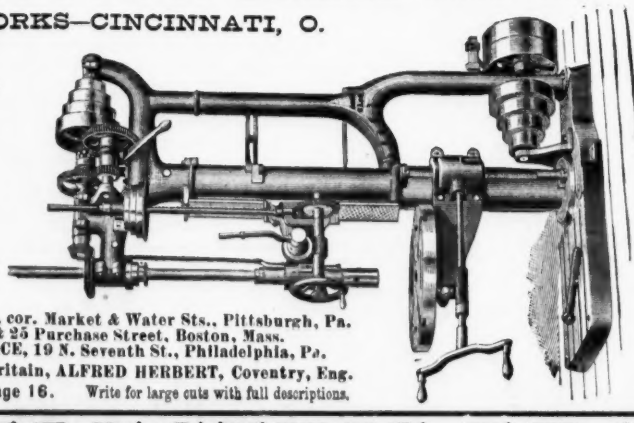

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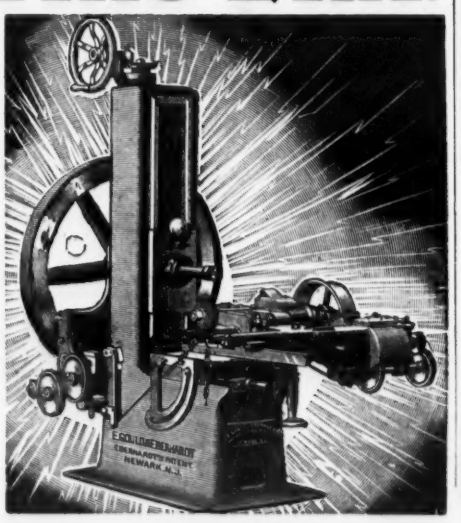

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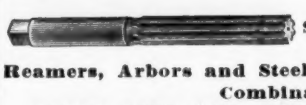

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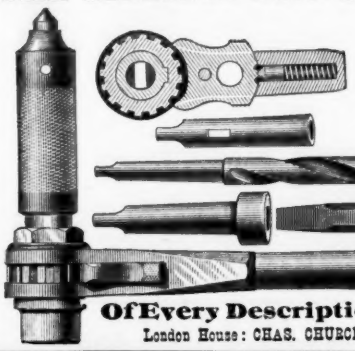

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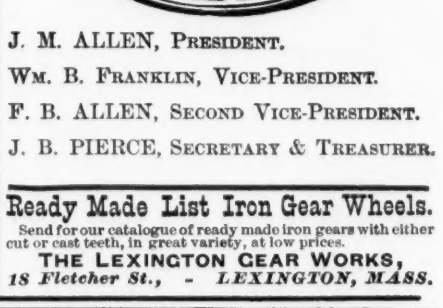

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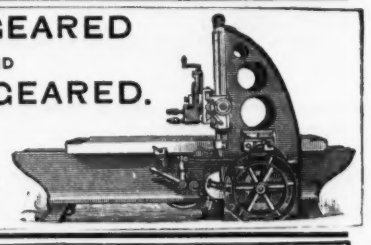

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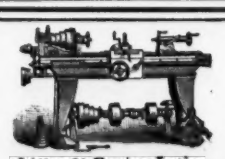

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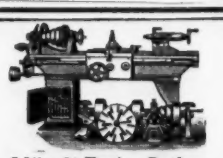

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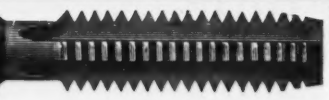

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